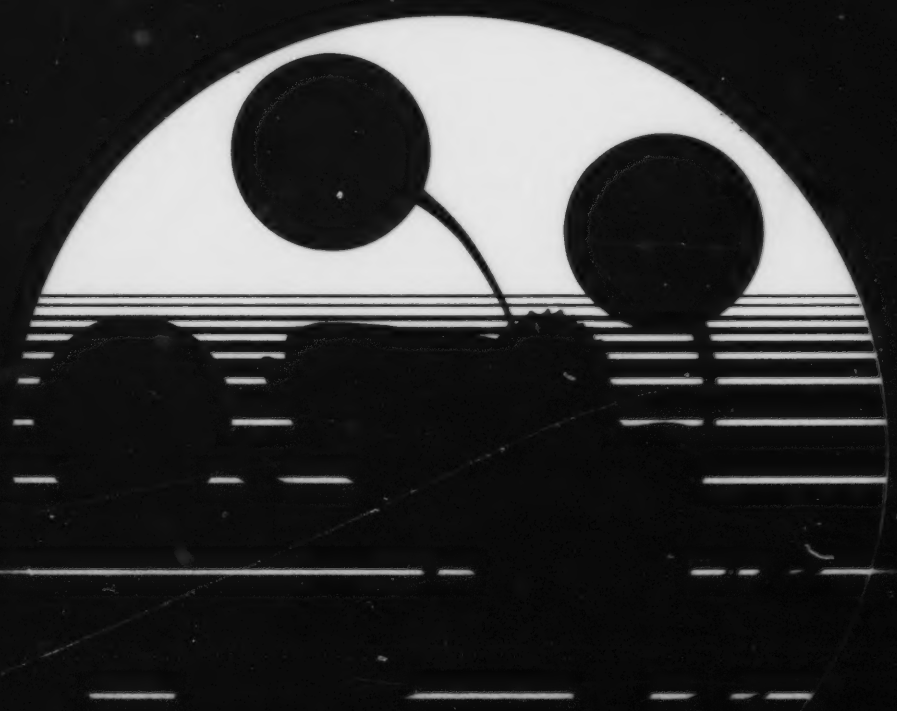
Guide to the Parasites of Fishes of Canada

Part III



GUIDE TO THE PARASITES OF FISHES OF CANADA

PART III

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Guide to the Parasites of Fishes of Canada

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Part III

Acanthocephala

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Part III

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PREFACE

Part III of the series bearing the general title "*Guide to the Parasites of Fishes of Canada*" contains Acanthocephala and Cnidaria. As we have pointed out in the Introduction to Part II, no taxonomic significance should be attached to the sequence in which these parts are issued. It reflects only the rate at which individual authors have been able to complete their contributions. The helminth–cnidarian assembly between the same covers is also fortuitous. As chance would have it, this part of the guide represents the relationship between the authors more than it does between the two groups of parasites it contains.

The format of Part III follows the pattern set by the previous two parts, i.e., it is an expanded key, incorporating salient features of all taxa encompassed in it. It differs from Part II in that it provides literature references for all host and distribution records, rather than sending the reader to Margolis and Arthur's (1979) synopsis for pre-1978 references and listing details only for the records subsequent to the cutoff point of that publication. Other minor differences were necessitated by the special characteristics of Acanthocephala, but readers acquainted with Parts I and II will find the format easy to follow.

The species representing Cnidaria has been included here for the sake of completeness. It cannot claim to be a parasite of fishes, but rather a hyperparasite associated with some ectoparasites of fishes. Its inclusion was prompted by repeated inquiries from the general public about its identity.

The cover design has been adapted from Mr. G. Klassen's original design for the cover of Part I. The aptness and esthetic appeal of that design have prompted its adoption, as far as possible, for the entire series.

THE EDITORS

ACANTHOCEPHALA

H. P. Arai

ABSTRACT

ARAI, H. P. 1989. Acanthocephala, p. 1–90. *In* L. Margolis and Z. Kabata [ed.]. Guide to the parasites of fishes of Canada. Part III. Can. Spec. Publ. Fish. Aquat. Sci. 107: 95 p.

Keys to identification of 32 species of acanthocephalans occurring either as adults or juveniles in fishes from Canadian waters are provided. Illustrations and brief descriptions of the various taxa are included as aids for identification.

RÉSUMÉ

ARAI, H. P. 1989. Acanthocephala, p. 1–90. *In* L. Margolis and Z. Kabata [ed.]. Guide to the parasites of fishes of Canada. Part III. Can. Spec. Publ. Fish. Aquat. Sci. 107: 95 p.

L'auteur fournit des clés d'identification pour les 32 espèces d'acanthocéphales que l'on rencontre au stade d'adultes ou de jeunes chez les poissons vivant dans les eaux canadiennes. Des illustrations et de courtes descriptions des divers taxons sont incluses pour faciliter l'identification.

INTRODUCTION

Van Cleave's (1920) records of three species of *Echinorhynchus* from Ontario, the western Arctic, and the Northwest Territories appear to be the first acanthocephalans reported from fishes in Canada. Up to 31 December 1986, a total of 32 species, including seven new species, have been reported from 145 species of fishes. Additionally, there have been a number of other acanthocephalan reports from Canada in which the worms were not specifically identified.

For the classification of the acanthocephalans, I have followed that presented by Amin (1982, 1985b, 1987), but I have also relied extensively on Meyer (1932, 1933), Van Cleave (1953b), Petrochenko (1956a, b), Golvan (1959b, 1960a, 1960b, 1960c, 1969), and Yamaguti (1963). I have also accepted the synonymies included in Amin (1985b); however, only those pertinent in the Canadian context have been listed.

The classification, synonymies, and common names given by Robins et al. (1980) have been followed for host species.

I have relied solely on the literature as a source for descriptions, morphometric data, and for illustrations. Since the informational content of the various sources differs greatly, results from attempts at separating poorly described species in a dichotomous key have been problematical. For the same reasons, difficulties were encountered in presenting the specific descriptions in a uniform manner. Similar circumstances have prevailed for the illustrations, which were usually redrawn from the original or redrawn as composites from two or more sources. Additional problems arose in constructing a key for members of the genera *Corynosoma* and *Bolbosoma*, which occur in fishes as juveniles or immature forms. The specific descriptions included here are based on the morphometric features of the adult stage; however, in the key to species, those characteristics (i.e., proboscis armature and trunk spination) that are useful for identification of juvenile forms have been emphasized. Unless otherwise indicated all morphometric values given in the specific descriptions are in millimetres.

Clarification is necessary for the omission of two names which have been introduced as part of the acanthocephalan fauna of Canada. *Echinorhynchus clavula* Dujardin, 1845 from *Eopsetta jordani* was listed by Ronald (1959) and attributed to an unpublished report by L. Margolis. However, Margolis (pers. comm.) has stated that he has never identified any specimens of *E. clavula* from any host. Hence, the purported record may have resulted from an error in transcription or from a transposition of hosts and parasites in a compilation process. Based on an unpublished report by Stewart-Hay (1952a), '*Tanaorhamphus*' was listed by Lubinsky (1976) and subsequently by Lubinsky and Loch (1979) as '*Tanaoramphus*' [sic]. Margolis and Arthur (1979)

listed *Tanaorhamphus*, but reference to Stewart-Hay's (1952a) original report indicates that the actual record is for '*Tanaorhynchus*', a *nomen nudum*. Until the identities of these specimens are confirmed, these 'records' from Canadian fishes should not be included in faunal lists.

Except for a few modifications, the general format (including abbreviations for denoting localities and the numerical convention for indicating authorities for host records and distributions) basically follows that of Margolis and Arthur (1979) and adopted by Beverley-Burton (1984). The main exception is that the host synonymies are not included in the 'Host–Parasite List' but the name used by the original authority is included as part of the host records. The Synopsis was also followed in designating geographical localities of the records shown in the keys. The following abbreviations were used: for marine areas, Arctic (Arc), Atlantic (Atl), eastern Arctic (E Arc), Pacific (Pac), and western Arctic (W Arc). For fresh waters, Alberta (Alta), British Columbia (BC), Labrador (Lab), Manitoba (Man), New Brunswick (NB), Newfoundland (Nfld), Northwest Territories (NWT), Nova Scotia (NS), Ontario (Ont), Prince Edward Island (PEI), Quebec (Que), Saskatchewan (Sask), Yukon Territory (YT), and unspecified Canadian locality (Can).

An undertaking such as this compilation cannot be completed to any degree of satisfaction without the aid and expertise of others. In this regard, I acknowledge Dr. L. Margolis and Mr. T. McDonald, both of the Pacific Biological Station, who generously shared their knowledge of the literature; Mr. G. Miller and his staff of the Pacific Biological Station library, who greatly facilitated the search of the literature; the University Research Grants Committee of the University of Calgary, which provided financial assistance for the rendering of the excellent illustrations by Ms. Danita Maslankowski of the Department of Biological Sciences, University of Calgary; the National Science and Engineering Research Council of Canada, through an operating grant (A-2405) to the author; and Dr. G.D. Schmidt, University of Northern Colorado, who read an earlier draft of the manuscript.

As an aid for interpreting the illustrations and identifying anatomical structures, a labelled drawing of the genitalia of a generalized palaeacanthocephalan is shown in Fig. 1.

KEYS TO ACANTHOCEPHALA

PHYLUM ACANTHOCEPHALA RUDOLPHI, 1808

General characteristics (modified after Hyman 1951 and Petrochenko 1956a): bilaterally symmetrical, endoparasitic worms of slender, cylindroid or slightly flattened and hollow construction; the diagnostic feature of the phylum is the organ of attachment consisting of an invaginable proboscis that forms the anterior end; this proboscis is armed with rows of recurved hooks; the body is covered by a syncytial epidermis under which is a musculocutaneous sac consisting of systems of longitudinal and circular muscles; between the epidermis and muscular layers lies a thick layer, the hypodermis, in which a lacunar system is located; the latter consists of two main dorsoventral or lateral longitudinal vessels and a network of small transverse, anastomosing canals; giant amoeboid nuclei or fragments of these are also present in the hypodermis; in connection with the proboscis apparatus, the epidermis forms two elongated bodies termed the lemnisci that hang down into the trunk; the nervous system consists of a ganglion near the proboscis and two lateral cords proceeding posteriorly from this, plus various minor nerves; mouth, anus, and digestive tube are completely lacking, and there is also no circulatory system; excretory organs, when present, are of the protonephridial type and open into the terminal part of the reproductive system; the hollow interior of the body is occupied by the reproductive systems; the sexes are separate; the female is generally larger than the male; the males are provided with a copulatory apparatus and the terminal part of the female apparatus is well-developed and somewhat complicated; the eggs containing partially formed embryos (acanthors) when shed, develop within the maternal body; an invertebrate host is required for hatching and development of the larva; the invertebrate host is always an arthropod, such as an insect, amphipod, or isopod; fishes may serve as additional hosts for forms having aquatic mammals or birds as definitive hosts; the adult parasites are found in the digestive tracts of various vertebrates, mainly fishes, birds, and mammals and occur throughout the world in marine, freshwater, and terrestrial hosts.

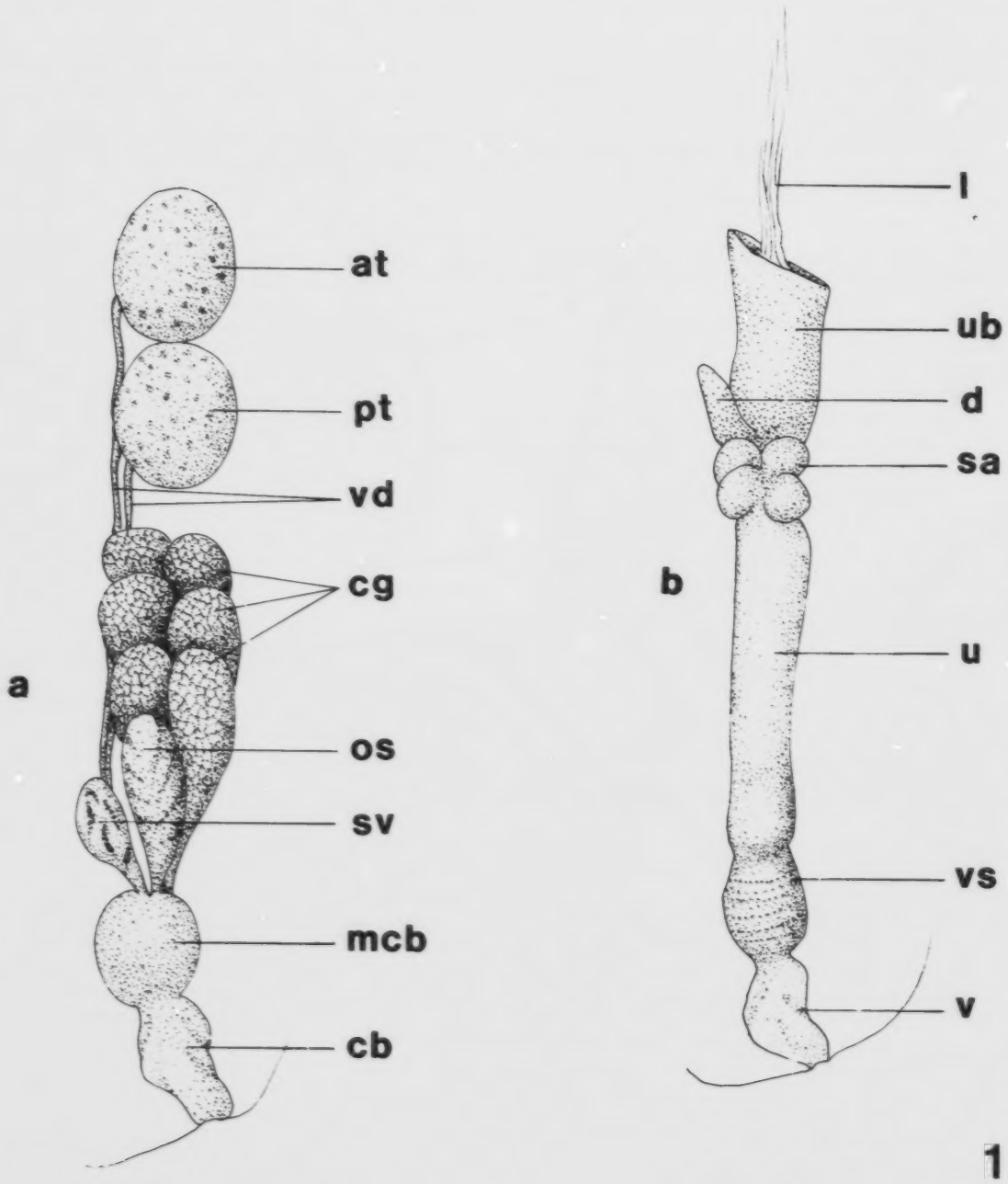

FIG. 1. Surficial aspects of genitalia of a generalized palaeacanthocephalan [redrawn after Golvan (1969)]: (a) male — at = anterior testis; pt = posterior testis; vd = vas deferens; cg = cement glands; os = organ of Saefftigen; sv = seminal vesicle; mcb = muscular portion of copulatory bursa; cb = membranous portion of copulatory bursa. (b) female — l = ligament; ub = uterine bell; d = diverticulum; sa = selective apparatus; u = uterus; vs = vaginal sphincter; v = vulva.

KEY TO CLASSES OF ACANTHOCEPHALA

Number of cement glands always greater than one, usually equal to or less than six, containing giant nuclei amitotically fragmented; proboscis receptacle double-walled; ligament sac of females precociously broken; main lacunar canals always lateral ..... Palaeacanthocephala

Always with a single syncytial cement gland, containing a few giant nuclei which are never fragmented and contiguous with a cement reservoir; proboscis receptacle single-walled; ligament sacs of females persistent; main lacunar canals dorsal and ventral, tending at times to turn laterally in posterior part of trunk ..... Eoacanthocephala

CLASS PALAEACANTHOCEPHALA MEYER, 1931

General characteristics (modified after Amin 1982): trunk aspinose or spinose; hypodermal nuclei fragmented, numerous and occasionally restricted to anterior half of trunk; proboscis retractable, with hooks arranged in alternating radial rows; proboscis receptacle double-walled, with ganglion near midlevel or at posterior end; main lacunar canals lateral; nuclei of lemnisci and cement glands fragmented; protonephridia lacking; single ligament sac of female precociously broken; males usually with six cement glands; eggs oval to elongate, with polar prolongations of the middle membrane in some species.

Key to orders of Palaeacanthocephala

Body usually aspinose; adults parasitic in lower vertebrates (mainly fishes and rarely amphibians and reptiles) ..... Echinorhynchida

Body usually spinose; adults parasitic in higher vertebrates, chiefly birds and mammals but also juveniles of some species in fishes, amphibians, and reptiles ..... Polymorphida

Order Echinorhynchida Southwell and MacFie, 1925

General characteristics (modified after Southwell and MacFie 1925, Yamaguti 1963, and Amin 1982): body usually small, aspinose, never pseudosegemented; hypodermal nuclei usually small, numerous; proboscis cylindrical to spheroid, with longitudinal, regularly alternating rows of hooks that vary in number; proboscis receptacle inserted at base of proboscis; cement gland divided into two or more compact or tubular lobes; eggs usually with prolongations of middle membrane; embryos with hooks at each end.

Key to families of Echinorhynchida

1 Four cement glands ..... Fessisentidae

More than four cement glands 2

2 Eight cement glands ..... Rhadinorhynchidae

Six cement glands 3

3 Proboscis supported by a very long neck (> 1.0 mm) or false neck ..... Pomphorhynchidae

Proboscis supported by a short neck (< 0.5 mm) ..... Echinorhynchidae

FESSISENTIDAE Van Cleave, 1931

General characteristics (modified after Van Cleave 1931, Haley and Bullock 1953, Golvan 1960b, 1969, Yamaguti 1963, and Amin 1982): body medium to large; trunk very elongated, thin, cylindroid, sometimes slightly enlarged posteriorly, aspinose; proboscis short to medium length, claviform, armed with numerous, small hooks arranged in longitudinal rows, with hooks becoming progressively smaller posteriorly; proboscis receptacle somewhat enlarged posteriorly, inserted at base of proboscis, with ganglion at base; lemnisci as long or up to twice length of receptacle; one or two, very elongate, cylindrical, contiguous or slightly separate tandem testes occupying posterior two-thirds of trunk; cement glands four, of variable form; two long diverticula at base of uterine bell; eggs elongate, ellipsoidal, with polar prolongations of middle membrane.

One genus in freshwater fishes of Canada.

Fessisentis Van Cleave, 1931

Diagnosis (modified after Van Cleave 1931, Petrochenko 1956a, Yamaguti 1963, Golvan 1969, and Nickol 1972): body cylindrical, of moderate length, aspinose; proboscis (Fig. 2b) of variable length, clavate to cylindrical, armed with numerous small, weak hooks arranged in 12–16 longitudinal rows; proboscis receptacle with posterior thickening containing several prominent nuclei, with ganglion in posterior third of receptacle; lemnisci usually twice length of receptacle; male reproductive organs occupying posterior three-fourths of trunk; testes one or two, very elongate, cylindrical, slender, tandem, contiguous; cement glands four, elongate, pyriform; female gonopore terminal to subterminal; eggs elongate, with polar prolongations of middle membrane, but lacking polar knobs.

One species in freshwater fishes of Canada.

Fessisentis friedi (Haley and Bullock, 1953) Nickol, 1962 (Fig. 2)

Synonym: *Fessisentis vancleavei* Haley and Bullock, 1953

Description (modified after Haley and Bullock 1953, Fried and Koplin 1967, and Nickol 1972): with the characters of the genus.

Males (Fig. 2a): 5.0–11.3 long, 0.39–0.53 wide, at posterior level of proboscis receptacle; proboscis (Fig. 2b) subcylindrical or clavate, 0.355–0.470 long, 0.096–0.180 wide, armed with 12–16 longitudinal rows of 8–9 hooks each; apical second or third hooks largest, 33–49 μm long; basal hooks 17–33 μm long; proboscis receptacle 0.52–1.10 long, with cap-like posterior region with about seven nuclei in posterior outer wall and about five nuclei in posterior inner wall; lemnisci from one-half to twice length of receptacle, 0.66–0.98 long; testes contiguous, filiform, 3.30–6.20 long, 0.13–0.42 wide; male genitalia occupying from three-fourths to four-fifths of length of total body cavity; cement glands four, elongate, clavate; ligament strand extending from cap-like projection on testes to proboscis receptacle; proboscis retractors and single retinaculum penetrating receptacle.

Females (Fig. 2c): body 6.0–14.5 long, 0.44–0.79 wide at level just posterior to proboscis receptacle; proboscis subcylindrical or clavate, slightly larger than in males, 0.30–0.52 long, 0.13–0.22 wide, armed with 13–21 longitudinal rows of 8–11 hooks each; second apical hooks largest, 38–46 μm long; basal hooks 17–23 μm long; proboscis receptacle 0.60–1.40 long; lemnisci one-half to twice length of receptacle, 0.56–1.30 long; eggs 69–154 μm long, 26–73 μm wide.

Site: spiral valve

Host: *Acipenser brevirostrum*.

Record: Appy and Dadswell 1978 (NB).

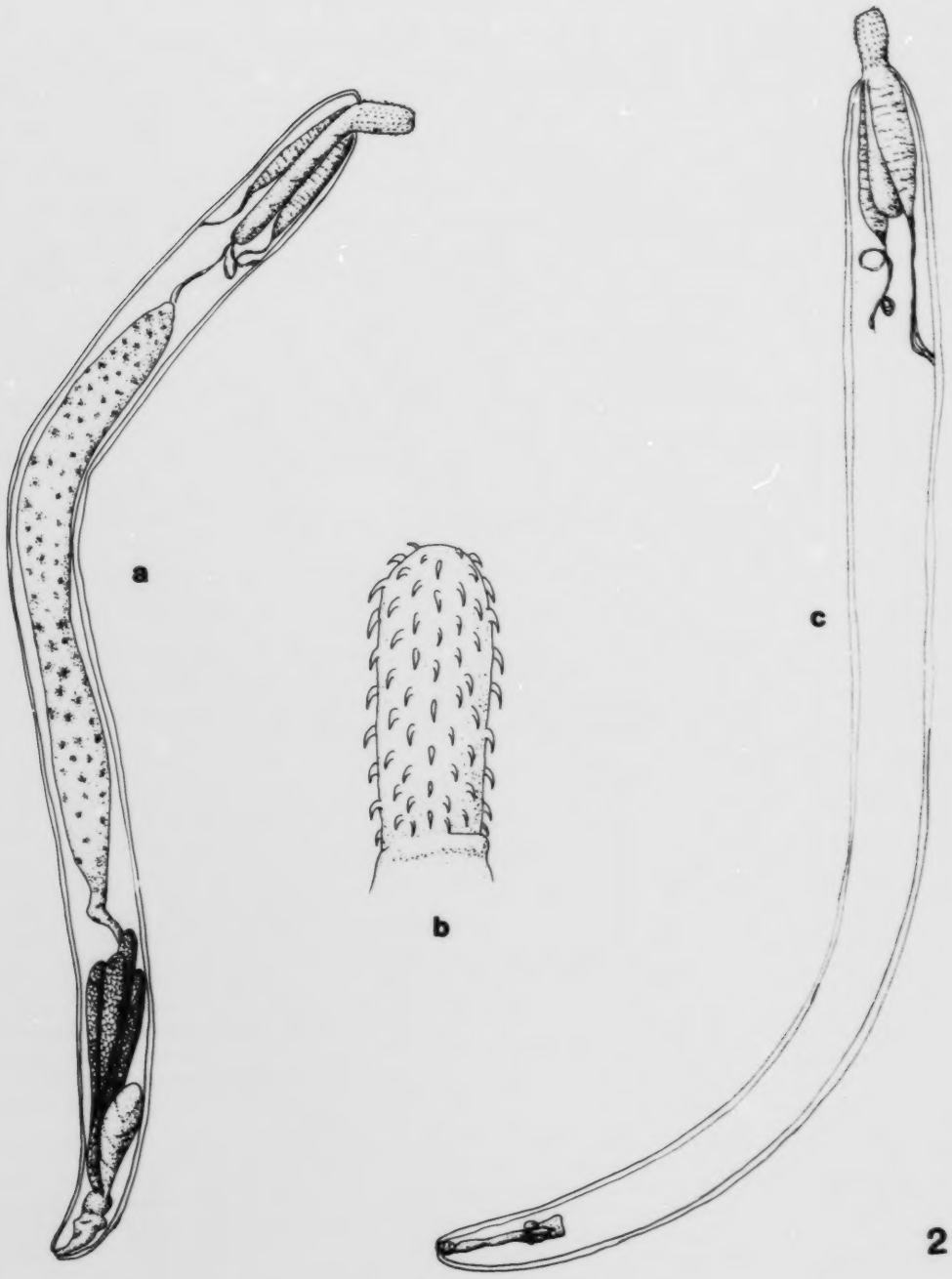

FIG. 2. *Fessisentis friedi* [all redrawn after Fried and Koplin (1967)]: (a) male; (b) proboscis; (c) female.

RHADINORHYNCHIDAE Travassos, 1923

General characteristics (modified after Golvan 1960a, Yamaguti 1963, and Amin 1982): body medium to large; trunk slender, or enlarged in anterior or middle third, spined extensively or on anterior region only, or occasionally in two fields posteriorly and anteriorly or randomly; body spines may be lost secondarily or present in young individuals only; hypodermal nuclei large, few, and extensively branched or small, numerous and fragmented; proboscis long or short, claviform to cylindrical, armed with longitudinal rows of hooks with roots of simple form, frequently with distinct dorsoventral asymmetry of hooks; proboscis receptacle double-walled, usually cylindrical, with ganglion at various levels in posterior portion; lemnisci usually slender, variable in length, or at least as long as receptacle; testes contiguous or not, usually in middle third of trunk, occasionally more anterior; cement glands 2–8, variable in shape; eggs elongate or oval, with polar prolongations of middle membrane; genital spines present in females of some species.

Key to genera of Rhadinorhynchidae

Trunk aspinose; eight cement glands ..... *Leptorhynchoides*

Trunk spinose; two cement glands ..... *Rhadinorhynchus*

Leptorhynchoides Kostylew, 1924

Diagnosis (modified after Kostylew 1924, Petrochenko 1956a, Golvan 1960a, 1969, and Yamaguti 1963): trunk cylindrical, of reduced size; giant hypodermal nuclei few, dentritic; longitudinal parietal musculature in four bands; proboscis very long, subcylindrical or claviform, armed with 12–14 longitudinal rows of 8–24 hooks each; proboscis receptacle cylindrical, double-walled, with ganglion located anteriorly; lemnisci long, tubular to filiform, considerably longer than receptacle; testes contiguous, post-equatorial or equatorial; cement glands eight, compact, spherical, grouped together immediately posterior to testes; eggs fusiform, long, slender, with polar prolongations of middle membrane.

One species in freshwater fishes of Canada.

Leptorhynchoides thecatus (Linton, 1891) Kostylew, 1924 (Fig. 3)

Synonym: *Echinorhynchus thecatus* Linton, 1891

Description (modified after Linton 1891, Van Cleave 1919, 1924, Lincicome and Van Cleave 1949, Petrochenko 1956a, and Yamaguti 1963): body cylindrical, usually arcuate, attenuated slightly anteriorly, sometimes enlarged and rounded posteriorly; neck short, conical, aspinose, about one-quarter length of proboscis; proboscis (Fig. 3b) fusiform, often obliquely inclined to longitudinal axis of trunk, armed with 12–14 longitudinal rows of 11–16 hooks each; ventral hooks strongly recurved; dorsal hooks arcuate; all hooks decreasing in size posteriorly; hooks ensheathed by epidermis, with sheath enclosing base and about one-half length of hooks; proboscis receptacle 1.5 times length of proboscis, double-walled, with ganglion near mid-level or somewhat more anteriorly; lemnisci very long, slender, reaching level of second testis in male but often doubled back, 1.5 times length of receptacle.

Males (Fig. 3c): body 3.0–12.0 long, 0.442–1.30 wide anteriorly, 0.16–0.26 medially, 0.17–0.31 wide posteriorly; neck 0.26 long; proboscis 0.75–0.97 long, 0.22 wide apically, 0.158–0.260 wide medially, 0.169–0.316 wide basally; hooks similar in size to those of female; proboscis receptacle 1.0–1.9 long, 0.221–0.378 wide; lemnisci 4.20 long, 0.08 wide, extending to anterior testis; anterior testis 0.196–0.855 long, 0.138–0.442 wide; posterior testis 0.172–0.658 long, 0.128–0.491 wide; cement glands eight, usually in patterns of 3-3-2, 2-3-3 or 4-3-1.

Females (Fig. 3a): body 5.0–26.0 long, 0.457–1.40 wide anteriorly, 0.90 wide posteriorly; neck 0.26 long, proboscis 0.790–1.164 long, 0.20 wide apically, 0.149–0.309 medially, 0.176–0.295 at base; apical proboscis hooks 45–90 μm long; median hooks 67–98 μm long; basal hooks 34–74 μm long; proboscis receptacle 1.30–2.45 long, 0.196–0.393 wide; lemnisci 5.0 long; eggs 65–110 μm long, 15–30 μm wide, with prominent knob-like extensions at each pole.

Sites: intestine, mesenteries

FIG. 3. *Leptorhynchoides thecatus:* (a) female [redrawn after Meyer (1932)]; (b) proboscis [redrawn after Linton (1891)]; (c) male [redrawn after Linton (1891)].

Hosts: *Ambloplites rupestris* (2, 9, 13); *Amia calva* (2, 9); *Anguilla rostrata* (3 (as *Anguilla bostoniensis*), 11); *Aplodinotus grunniens* (2); *Catostomus catostomus* (9); *C. commersoni* (13, 16); *Coregonus clupeaformis* (3, 5); *Culaea inconstans* (13); *Cyprinus carpio* (2); *Esox lucius* (6, 8, 9, 13, 18); *E. masquinongy* (6, 7, 13, 18); *Etheostoma caeruleum* (9 (as *Poecilichthys caeruleum*)); *E. exile* (2 (as *Poecilichthys exilis*), 18); *E. flabellare* (2 (as *Catonotus flabellaris*)); *E. nigrum* (9 (as *Boleosoma nigrum*), 13); *Hybopsis storeriana* (2 (as *Erinemus storeriana*)); *Ictalurus melas* (2 (as *Ameiurus melas*)); *I. nebulosus* (3 (as *Ameiurus nebulosus*), 9 (as *A. nebulosus*), 13); *I. punctatus* (2); *Lepisosteus osseus* (2); *Lepomis gibbosus* (2 (as *Eupomotis gibbosus*), 3, 5, 6, 9, 13); *L. macrochirus* (2 (as *Helioperca incisor*)); *Lota lota* (3 (as *Lota maculosa*), 5 (as *Lota maculosa*), 13); *Microgadus tomcod* (1); *Micropterus dolomieui* (2, 3, 5, 6, 8, 9, 13); *M. salmoides* (2, 9); *Morone chrysops* (9 (as *Lepibema chrysops*), 19); *Moxostoma anisurum* (13); *Notropis anogenus* (13); *N. hudsonius* (9); *Noturus flavus* (2); *N. gyrinus* (13); *Oncorhynchus nerka* (16); *Osmerus mordax* (1, 12); *Perca flavescens* (2, 3, 5, 6, 9, 10, 13, 14 (as *Perca fluviatilis*), 15, 16); *Percina caprodes* (2, 13); *Percopsis omiscomaycus* (2); *Pomoxis annularis* (2); *P. nigromaculatus* (2 (as *Pomoxis sparoides*), 13); *Pungitius pungitius* (13); *Rhinichthys atratulus* (13); *Salvelinus fontinalis* (5); *S. namaycush* (4, 5); *Stizostedion vitreum vitreum* (2, 6, 9); *Umbra limi* (13); unspecified centrarchid fishes (20).

Records: 1. Pigeon and Vallée 1937 (Que); 2. Bangham and Hunter 1939 (Ont); 3. Bangham 1941 (Ont); 4. MacLulich 1943 (Ont); 5. Bangham and Venard 1946 (Ont); 6. Lincicome and Van Cleave 1949 (Ont); 7. Choquette 1951 (Que); 8. Worley and Bangham 1952 (Ont); 9. Bangham 1955 (Ont); 10. Tedla and Fernando 1969 (Ont); 11. Hanek and Threlfall 1970c (Lab); 12. Threlfall and Hanek 1971 (Lab); 13. Dechtiar 1972b (Ont); 14. Tedla and Fernando 1972 (Ont); 15. Cannon 1973 (Ont); 16. Collins and Dechtiar 1974 (Ont); 17. Anthony 1982 (Ont); 18. 1983 (Ont); 19. 1984 (Ont); 20. 1985 (Ont).

Remarks: Anthony's (1982) record was reported as *Leptorhynchoides* (probably *thecatus*). In Anthony's (1985) report, the centrarchids examined, but not necessarily stated as hosts, were: *Ambloplites rupestris*, *Lepomis gibbosus*, *L. macrochirus*, *Micropterus dolomieui*, *M. salmoides*, and *Pomoxis nigricans*.

Leptorhynchoides sp.

Site: intestine

Host: *Stizostedion vitreum glaucum* (as *S. glaucum*)

Record: Bangham and Hunter 1939 (Ont).

Rhadinorhynchus Lühe, 1911
Synonym: *Nipporhynchus* Chandler, 1934

Diagnosis (modified after Van Cleave 1919, Petrochenko 1956a, Golvan 1960a, 1969, and Yamaguti 1963): trunk elongate, subcylindrical, somewhat enlarged anteriorly, with one or two fields of body spines separated by an aspinose region; body spination generally covering a triangular surface with lower point ventrad; hypodermis with numerous fragments of giant nuclei; main lacunar canals lateral, united by anastomoses forming a network; proboscis very long, claviform, armed with 8–26 longitudinal rows of 8–37 hooks each; hooks showing distinct dorsoventral asymmetry, with ventral hooks stouter, larger; proboscis receptacle long, double-walled, with ganglion at mid-level; lemnisci digitiform, always distinctly longer than receptacle; male genitalia occupying posterior half of trunk; testes two, ovoid to elongate, tandem, contiguous; cement glands 2–8, club-shaped; gonopore terminal in both sexes; eggs with large polar prolongations of middle membrane. Parasitic in marine fishes.

Key to species of *Rhadinorhynchus*

1 Proboscis armed with 14–16 longitudinal rows of hooks ..... *R. pristis* (Rudolphi, 1802) Lühe, 1911 (Fig. 4)

Description (modified after Meyer 1932, Chandler 1934, Yamaguti 1963, and Golvan 1969): with the characters of the genus.

Males (Fig. 4a): body up to 20.0 long, 0.6–0.9 wide; proboscis (Fig. 4b) up to 2.5 long, strongly flexed, subcylindrical, enlarged slightly anteriorly, armed with 14–16 longitudinal rows of 26 hooks each; ventral hooks of anterior two-thirds of proboscis weaker, slightly shorter than others; basal hooks forming a ring, almost perpendicular to surface of proboscis; surface of body with anterior and posterior fields of spines; anterior field encircling trunk entirely; posterior field restricted to ventral surface, extending further posteriorly in females than in males; testes elongate, tandem, in posterior half of trunk, 1.7 long, 0.35–0.40 wide; cement glands nearly as long as both testes.

Females (Fig. 4c): body up to 75 long, about 1.12 wide; uterus very long; uterine bell located near mid-level of trunk; eggs elongate, with middle membrane striated externally, 120 μm long, 20 μm wide.

Site: intestine

Host: *Xiphias gladius*.

Records: Hogans et al. 1983 (Atl).

Proboscis armed with 12 or less longitudinal rows of hooks 2

2 Proboscis armed with 12 longitudinal rows of 22–24 hooks each ..... *R. trachuri* Harada, 1935 (Fig. 5)

Synonyms: *Nipporhynchus trachuri* (Harada, 1935) Van Cleave and Lincicome, 1940; *Nipporhynchus* sp. *sensu* Margolis 1956, 1957.

Description (modified after Harada 1935, Yamaguti 1963, and Golvan 1969): trunk somewhat enlarged anteriorly, subcylindrical posteriorly, with distinct dorsiflexion; trunk spination in anterior and posterior fields separated by an aspinose zone; anterior field encircling trunk entirely; posterior field triangular, with inferior point ventral, interrupted dorsally; anterior trunk spines 50 μm long; 60 μm long in posterior field; proboscis cylindrical, 1.7 long, 0.15 wide, nearly perpendicular to longitudinal axis of trunk; proboscis armed with 12 longitudinal rows of 22–24 hooks each; hooks showing dorsoventral asymmetry, with ventral hooks somewhat larger and stouter than dorsal hooks; ventral hooks 70–80 μm long; dorsal hooks 58–70 μm long; lemnisci slightly flattened, narrow, slightly longer than receptacle, expanded posteriorly; proboscis receptacle attenuated posteriorly, 1.6 long, 0.115 wide, double-walled, with ganglion near mid-level.

Males (Fig. 5): body 7.5 long, 0.6 wide; testes tandem, 0.70 long, 0.40 wide, situated sub-equatorially in posterior half of trunk; cement glands four, in two anteroposterior pairs, club-shaped; posterior testis larger than anterior.

Females: body 10.0 long, 0.6 wide; uterus and uterine bell about 1.2 long; eggs 73 μm long, 20 μm wide.

Site: intestine

Hosts: *Clupea harengus pallasi* (4); *Oncorhynchus gorbuscha* (1); *O. kisutch* (5, 6); *O. nerka* (1, 2, 3).

Records: 1. Margolis 1956 (BC); 2. 1957 (Pac, BC); 3. 1963 (Pac); 4. Arthur and Arai 1980a (Pac); 5. Anonymous 1981 (BC); 6. 1984 (BC).

Proboscis armed with 10 longitudinal rows of 20-21 hooks each ..... *R. cololabis* Laurs and McCauley, 1964 (Fig. 6)

Description (modified after Laurs and McCauley 1964 and Hughes 1973): with the characters of the genus.

Males (Fig. 6c): body 7.5–14.0 long, 0.86–1.01 in greatest width; proboscis 1.60–1.96 long, 0.13–0.20 wide; apical hooks 48–64 μm long ventrally, 63–69 μm long dorsally; median hooks 55–64 μm long ventrally, 41–55 μm long dorsally; basal hooks 48–64 μm long ventrally, 44–58 μm long dorsally; proboscis receptacle 2.40–3.14 long, 0.23–0.30 wide, with ganglion at mid-level; anterior trunk spines 30–39 μm long ventrally, 28–46 μm long dorsally; posterior trunk spines 34–51 μm long; testes two, ovoid, tandem, in mid-third of trunk; anterior testis 1.20–1.76 long, 0.40–0.70 wide; posterior testis 0.80–2.20 long, 0.35–0.60 wide; cement glands four, in posterior third of trunk; anterior pair reaching level of posterior testis; posterior pair about two-thirds of this distance; without genital spines.

FIG. 4. *Rhadinorhynchus pristis:* [all redrawn after Meyer (1932)]: (a) male; (b) proboscis; (c) female.

FIG. 5. *Rhadinorhynchus trachuri:* male [redrawn after Harada (1935)].

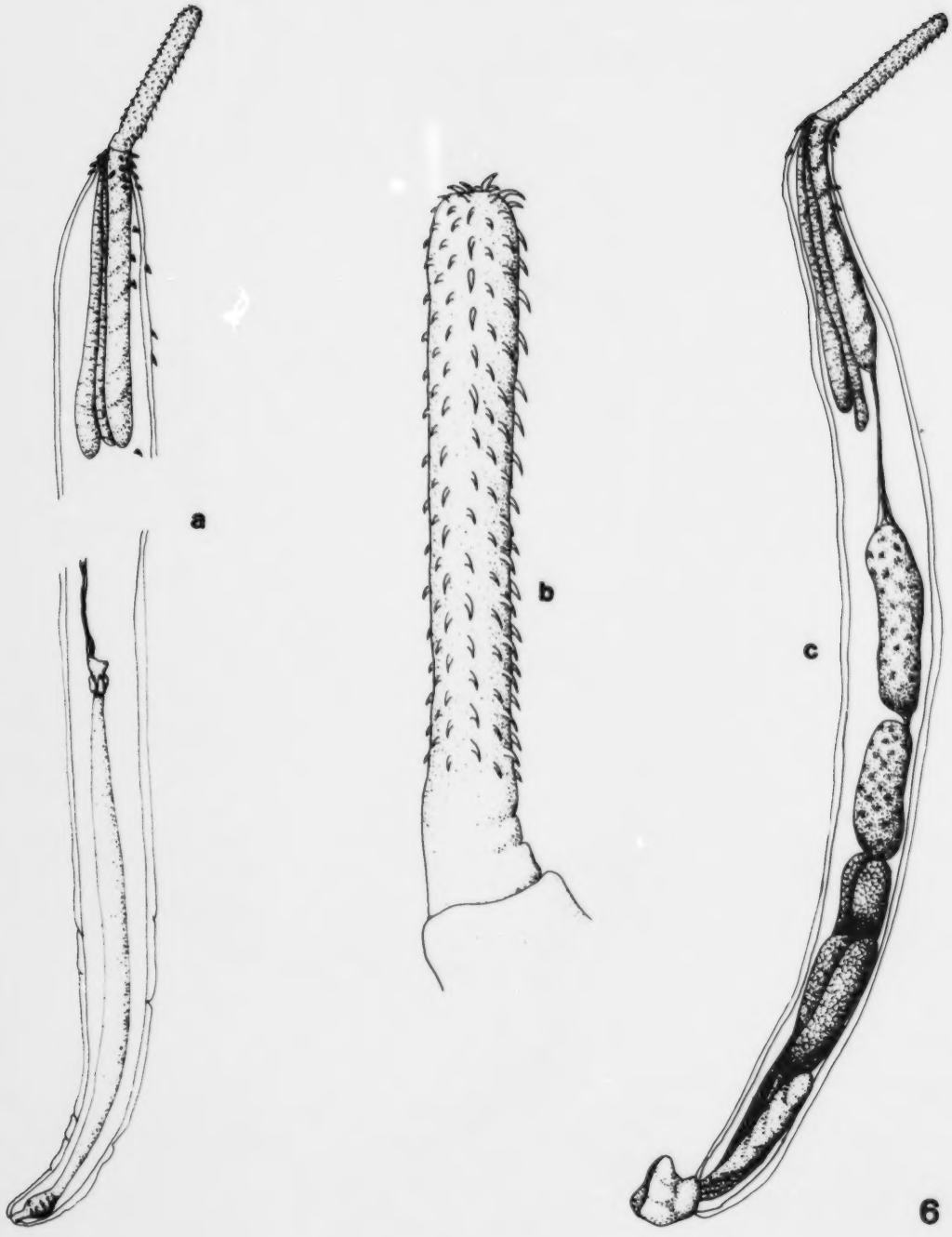

FIG. 6. *Rhadinorhynchus cololabis* [all redrawn after Laurs and McCauley (1964)]: (a) female; (b) proboscis; (c) male.

Females (Fig. 6a): body 13.5–35.0 long, 0.88–1.62 wide; proboscis rarely fully everted, 0.18–0.21 wide; median proboscis hooks 80–81 μm long ventrally, 64–78 μm long dorsally; basal hooks 70–84 μm long ventrally, 55–76 μm long dorsally; proboscis receptacle 2.32–3.50 long, 0.127–0.33 wide; anterior trunk spines 46–58 μm long ventrally, 41–59 μm long dorsally; posterior trunk spines 60–74 μm long; trunk almost completely filled with eggs; eggs 57–75 μm long, 9–14 μm wide, with polar prolongations of middle membrane; uterus long, mouth of uterine bell about one-fourth length of trunk from posterior end.

Site: intestine

Host: *Cololabis saira*.

Record: Hughes 1973 (Pac).

POMPHORHYNCHIDAE Yamaguti, 1939

General characteristics (modified after Yamaguti 1939, 1963, Golvan 1960b, 1969, and Amin 1982): body of medium size; trunk aspinose, cylindroid; hypodermis thick, with numerous fragments of giant nuclei; main lacunar canals lateral, with anastomoses forming a network; proboscis of variable size, cylindroid or clavate, armed with hooks in uniform longitudinal rows; neck always very long, cylindroid or spirally twisted, with or without bulbous enlargement; proboscis receptacle long, inserted at base of proboscis, ganglion in posterior third of receptacle; lemnisci shorter than receptacle, sometimes rudimentary; male organs in mid-region of trunk; testes oval, tandem, contiguous; cement glands 4–6, usually compact, pyriform; copulatory bursa with two anterior diverticula, with numerous digitiform rays; eggs ellipsoidal, with thin, smooth membranes, with polar prolongations of middle membrane.

One genus in freshwater fishes of Canada.

Pomphorhynchus Monticelli, 1905

Diagnosis (modified after Van Cleave 1919, 1924, Petrochenko 1956a, Golvan 1960b, 1969, and Yamaguti 1963): body small to medium size, fusiform; trunk aspinose, slightly enlarged anteriorly; hypodermal nuclei small, numerous; false neck very long, cylindrical but forming globular bulb anteriorly; proboscis long, inserting on bulb of false neck, subcylindrical, armed with 12–20 longitudinal rows of 10–18 hooks each; hooks progressively decreasing in size posteriorly; basal hooks with rudimentary roots; proboscis receptacle very long, extending posteriorly through length of neck, with ganglion at base; lemnisci short, claviform; testes ovoid, tandem, contiguous, in posterior two-thirds of trunk; cement glands six, ovoid to spherical; gonopore terminal in both sexes, not surrounded by spines; eggs fusiform, with polar prolongations of middle membrane.

Proboscis armed with 12 longitudinal rows of 12–14 hooks each .... *P. bulbocolli* Linkins in Van Cleave, 1919 (Fig. 7)

Description (modified after Van Cleave 1919, 1924, Petrochenko 1956a, Yamaguti 1963, and Golvan 1969): body elongate, attenuating posteriorly; neck prominent, much narrower than anterior region of trunk 2.6–4.0 long, 0.15–0.40 in diameter posteriorly, bulb 0.8–1.5 in diameter; proboscis cylindrical, 0.50–0.60 long, 0.07–0.20 wide, armed with 12 rows of 12–14 hooks each; basal circle forming a complete ring of 12 hooks; remaining circles with 6 hooks each; hooks in circles anterior to basal circle alternating; apical hooks 16 μm long, 4 μm wide; largest hooks in seventh or eighth circles, 36–40 μm long, 22 μm wide; hooks posterior to eighth circle 20–36 μm long, 4–8 μm wide; roots of hooks of first eight circles 10–40 μm long; eggs 53–83 μm long, 8–13 μm wide.

Site: intestine

Hosts: *Ambloplites rupestris* (10); *Amia calva* (10); *Aplodinotus grunniens* (12); *Carpiodes cyprinus* (12, 13); *Catostomus catostomus* (9); *C. commersoni* (2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 17, 19, 20, 23, 25, 26); *C. macrocheilus* (9, 19, 24, 26, 28); *Coregonus artedii* (15, 17, 18, 21, 23); *C. clupeaformis* (15, 17, 18, 21, 23, 25, 26, 28); *Cottus asper* (9); *C. rhotheus* (9); *Cyprinus carpio* (10, 21); *Esox lucius* (10); *Hiodon tergisus* (12, 22); *Ictalurus nebulosus* (3 (as *Ameiurus nebulosus*), 5 (as *Ameiurus nebulosus*), 10 (as *Ameiurus nebulosus*), 12, 13); *Lepomis gibbosus* (12); *Lota lota* (9, 10 (as *Lota maculosa*), 13); *Micropterus dolomieui* (10, 12); *Moxostoma anisurum* (12); *M. erythrurum* (12); *M. macrolepidotum* (7 (as *Moxostoma aureolum*)); *Mylocheilus caurinus* (9, 27, 28); *Notropis hudsonius* (10); *Noturus gyrinus* (13); *Oncorhynchus kisutch* (9, 15, 17, 23); *O. nerka* (14); *Osmerus mordax* (10, 20); *Perca flavescens* (10, 11 (as *Perca fluviatilis*), 20, 29); *Percina caprodes* (10, 13); *Percopsis omiscomaycus* (10, 14); *Phoxinus eos* (3); *Prosopium williamsoni* (9, 19, 24, 26, 28); *Ptychocheilus oregonensis* (9, 19, 24, 26, 27, 28); *Pungitius pungitius* (17, 23); *Richardsonius balteatus* (9); *Salmo clarki* (9); *S. gairdneri* (9, 19, 24, 25, 26, 27, 28); *S. salar* (16); *Salvelinus fontinalis* × *S. namaycush* (14, 20); *S. namaycush* (15, 17, 23); *Umbra limi* (10); unspecified fishes (1, 15).

Records: 1. Van Cleave 1924 (Can); 2. Bangham and Hunter 1939 (Ont); 3. Bangham 1941 (Ont); 4. Richardson 1942 (Que); 5. Bangham and Venard 1946 (Ont); 6. Stewart-Hay 1951a (Man); 7. 1951b (Man), 8. 1952a (Man); 9. Bangham and Adams 1954 (BC); 10. Bangham 1955 (Ont); 11. Tedla and Fernando 1972 (Ont); 12. Dechtiar 1972a (Ont); 13. 1972b (Ont); 14. Collins and Dechtiar 1974 (Ont); 15. Leong and Holmes 1974a (Alta); 16. Hare and Frantsi 1974 (NB); 17. Leong 1975 (Alta); 18. Watson 1977 (Man); 19. Anonymous 1978 (BC); Dechtiar and Berst 1978 (Ont); 21. Watson and Dick 1979 (Man); 22. Glenn 1980 (Man); 23. Leong and Holmes 1981 (Alta); 24. Anonymous 1981 (BC); 25. McAllister and Mudry 1983 (Alta); 26. Arai and Mudry 1983 (BC); 27. Anonymous 1983 (BC); 28. 1984 (BC); 29. Poole and Dick 1985 (Man).

Proboscis armed with 12 longitudinal rows of 15–18 hooks each .... *P. rocci* Cordonnier and Ward, 1967 (Fig. 8)

Description (modified after Cordonnier and Ward 1967 and Golvan 1969): body cylindrical, slightly enlarged anteriorly; distinct bulb just posterior to proboscis; neck and proboscis (Fig. 8a) 5 long in both sexes; proboscis fusiform, 0.51–0.93 long, 0.18–0.25 at widest point, with width at base 0.13–0.21, armed with 12 longitudinal rows with 15–18 hooks each; apical 4 hooks small, 23–31 μm long, with small posterior roots; fifth hooks large, 28–39 μm long, with posterior roots; sixth and seventh hooks small, 18–23 μm long, with posterior roots; last 10 hooks 28–39 μm long, with anteriorly directed roots; proboscis receptacle extending through length of neck and slightly into trunk approximately 5 long, 0.14 in diameter; lemnisci 0.65–1.56 long, 0.80–1.30 in diameter.

Males (Fig. 8b): body 12.0–17.0 long, 1.0 wide; testes in anterior part of trunk; anterior testis 0.83–1.56 long, 0.390–0.730 wide; posterior testis 0.98–1.63 long, 0.410–0.650 wide; cement glands six, ovate, 0.57–0.70 long.

Females: body 11.0–19.0 long, 1.0–1.56 wide; eggs elliptical, with polar prolongations of middle membrane, 65–84 μm long, 10–13 μm wide.

Site: intestine

Host: *Ambloplites rupestris*.

Record: Dechtiar 1972a (Ont).

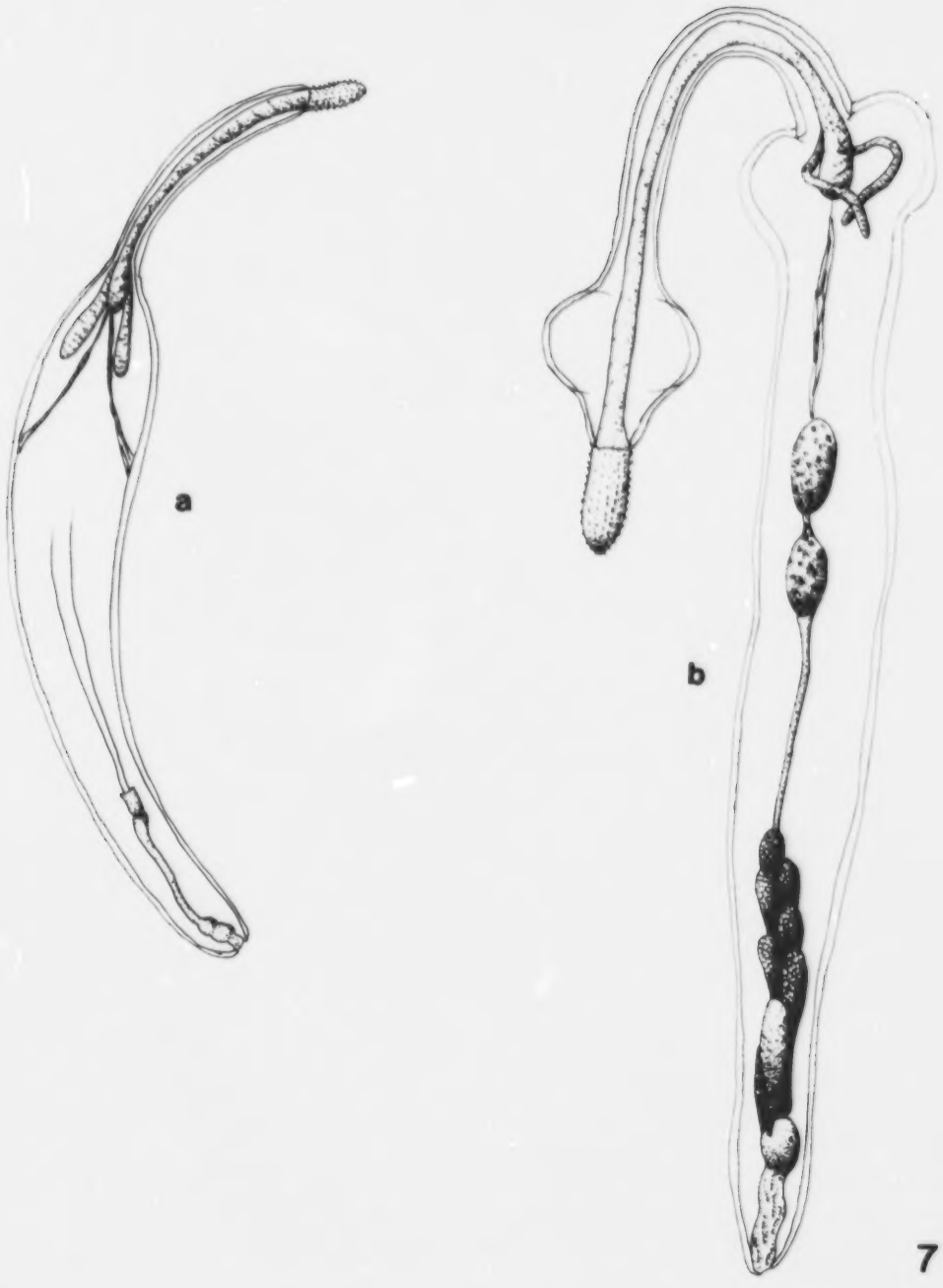

FIG. 7. *Pomphorhynchus bulbocolli* [both redrawn after Yamaguti (1963)]: (a) female; (b) male.

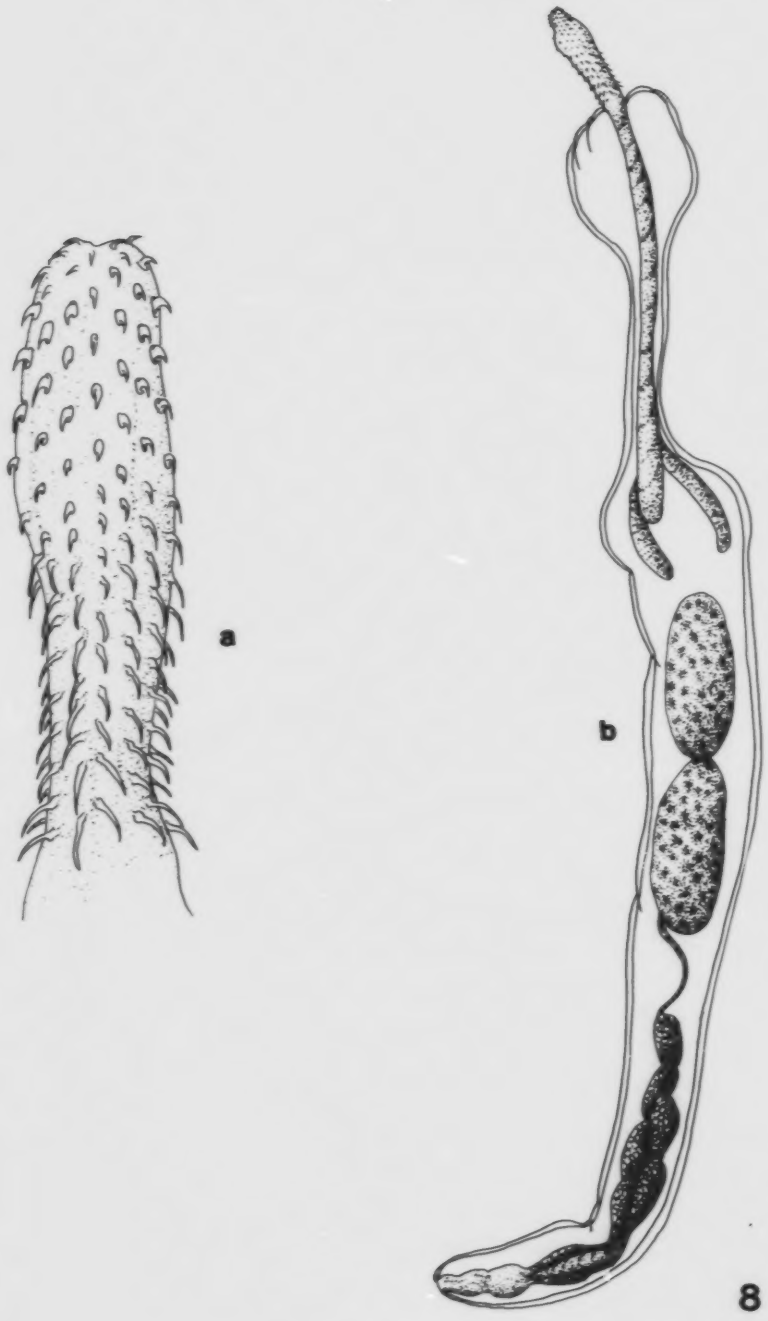

FIG. 8. *Pomphorhynchus rocci* [both redrawn after Cordonnier and Ward (1967)]: (a) proboscis; (b) male.

Pomphorhynchus sp.

Site: intestine

Hosts: *Carassius auratus* (1); *Catostomus commersoni* (4, 5); *Coregonus clupeaformis* (6); *Ictalurus punctatus* (1); *Lota lota* (6); *Notropis hudsonius* (2); *Stizostedion vitreum vitreum* (3)

Records: 1. Bangham and Hunter 1939 (Ont); 2. Stewart-Hay 1951a (Man); 3. 1951b (Man); 4. 1951c (Man); 5. 1952a (Man); 6. 1963 (Man); 6. McAllister and Mudry 1983 (Alta).

ECHINORHYNCHIDAE Cobbold, 1876

General characteristics (modified after Petrochenko 1956a, Golvan 1960b, 1969, Yamaguti 1963, and Amin 1982): body small, medium, or large, fusiform to cylindrical; hypodermal nuclei slender, usually small, numerous; proboscis more or less cylindrical, of moderate length, usually with numerous hooks or spherical with relatively few hooks; proboscis receptacle inserted at base of proboscis, ganglion at various levels; lemnisci two, more or less claviform, rather short, equal to or scarcely longer than receptacle; testes elliptical to oval; cement glands 4–8, usually pyriform to spherical, in varying arrangements; eggs elliptical to fusiform, usually with polar prolongations of middle membrane; main lacunar canals united by transverse anastomoses.

Key to Genera of Echinorhynchidae

Proboscis slightly swollen; ganglion at base of proboscis receptacle ..... *Acanthocephalus*

Proboscis cylindrical; ganglion near mid-level of proboscis receptacle .... *Echinorhynchus*

Acanthocephalus Koelreuther, 1771

Diagnosis (modified after Van Cleave 1919, Petrochenko 1956a, Golvan 1960b, 1969, and Yamaguti 1963): body small to medium size; trunk aspinose, subcylindrical; hypodermal nuclei small, numerous; lacunar system with reticular anastomoses; neck short; proboscis moderately long, ovoid or claviform to cylindrical, armed with 6–28 longitudinal rows of 4–15 hooks each; hooks increasing in size from apex to mid-region, then decreasing gradually toward base; basal hooks spine-like, with rudimentary roots; proboscis receptacle sacciform to cylindrical, with ganglion at base; lemnisci digitiform or claviform, usually shorter than receptacle; testes oval, tandem, contiguous or nearly so; cement glands six, pyriform to claviform, variably arranged, usually in three tandem pairs; uterus short; gonopore terminal; eggs elongate, fusiform, with prominent prolongations of middle membrane.

One species in freshwater fishes of Canada.

Acanthocephalus dirus (Van Cleave, 1931) Van Cleave and Townsend, 1936 (Fig. 9)

Synonyms: *Echinorhynchus dirus* Van Cleave, 1931; *Acanthocephalus jacksoni* Bullock, 1962; *A. parksidei* Amin, 1975

Description (modified after Van Cleave 1931, Van Cleave and Townsend 1936, Bullock 1962, Yamaguti 1963, and Golvan 1969): body cylindrical, elongate; trunk and all shared structures larger in females than in males; proboscis (Fig. 9b) long, cylindrical, with largest hooks at mid-level; all hooks with simple, unmodified roots; proboscis receptacle relatively longer and wider than proboscis; lemnisci variable in length, often slightly subequal, rarely multiple or irregularly formed.

Males (Fig. 9a): body 2.20–6.00 long, 0.32–1.50 wide near mid-level of trunk; proboscis subcylindrical, 0.31–0.742 long, 0.098–0.24 wide, armed with 11–20 longitudinal rows with 6–13 hooks each; largest hooks at mid-level of proboscis, with long slender roots, 35–84 μm long; proboscis receptacle 0.364–1.30 long, 0.042–0.322 wide; lemnisci one-half to slightly longer than receptacle, one or both sometimes lobed; testes spherical to elongate ellipsoidal, subequal in size, usually contiguous; anterior testis 0.308–1.01 long, 0.168–0.686 wide; posterior testis 0.21–0.924 long, 0.168–0.644 wide; cement glands spherical to clavate, 0–12 per male, 0.098–0.588 long, 0.084–0.42 wide.

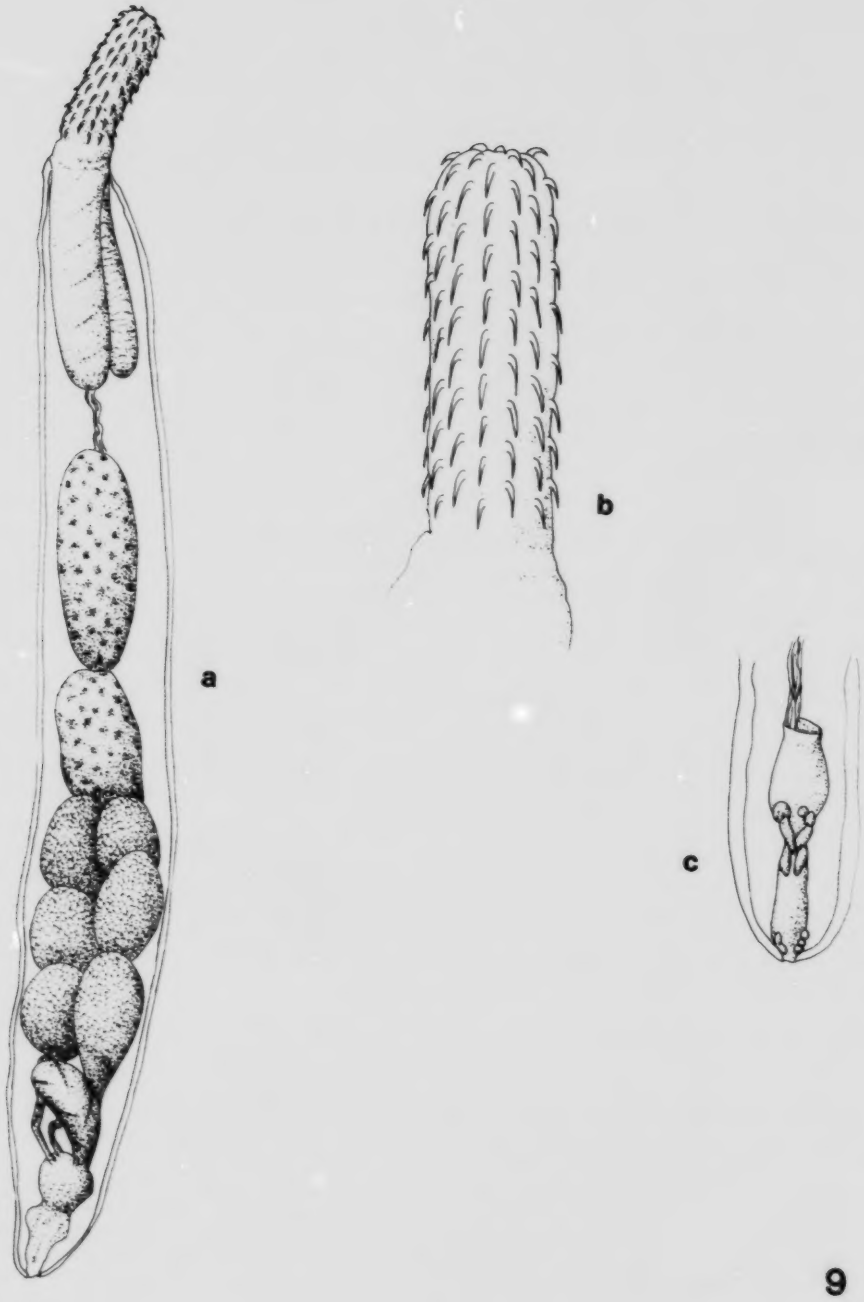

FIG. 9. *Acanthocephalus dirus* [all redrawn after Bullock (1962)]: (a) male; (b) proboscis; (c) terminal portion of female genitalia.

Females (Fig. 9c): body 2.40–20.0 long, 0.32–1.44 wide anteriorly, subcylindrical with greatest width near anterior end, attenuating slightly posteriad; proboscis 0.46–0.88 long, 0.14–0.39 wide, armature similar to that of males with respective hooks somewhat larger; proboscis receptacle 0.35–1.68 long, 0.14–0.378 wide; lemnisci 0.28–1.526 long, one-half to slightly longer than receptacle, 0.056–0.364 wide; eggs 51–150 μm long, 6–19 μm wide.

Site: intestine

Hosts: *Alosa pseudoharengus* (1, 2); *Catostomus commersoni* (1); *Coregonus clupeaformis* (1); *Oncorhynchus nerka* (1); *Perca flavescens* (1); *Salvelinus fontinalis* × *S. namaycush* (1, 2).

Records: 1. Collins and Dechtiar 1974 (Ont); 2. Dechtiar and Berst 1978 (Ont).

Acanthocephalus sp.

Site: intestine

Hosts: *Fundulus diaphanus* (1); 2. *Ictalurus nebulosus* (2).

Records: 1. Wiles 1975 (NS); 2. Fréchette et al. 1978 (Que).

Echinorhynchus Zoega in Müller, 1776
Synonym: *Metechinorhynchus* Petrochenko, 1956

Diagnosis (modified after Van Cleave 1919, Petrochenko 1956a, Golvan 1960b, 1969, Yamaguti 1963, and Amin and Redlin 1980): body slender, aspinose, subcylindrical, small to medium size, sometimes enlarged anteriorly; hypodermis with numerous, small nuclear fragments or with few, very large nuclei; proboscis thin, relatively long, cylindrical, often bent ventrad, with large numbers of hooks; hooks mostly uniform but posteriormost hooks much reduced and without roots; proboscis receptacle with ganglion at mid-level or more posteriorly, inserted at base of proboscis; lemnisci usually digitiform, about as long as receptacle or leaf-shaped and then shorter than receptacle; testes oval to elliptical, tandem, contiguous or not, usually in middle or posterior third of trunk; cement glands six, spherical, variously arranged; neck very short; main lacunar canals lateral, with reticular anastomoses; eggs fusiform, with narrow flask-shaped polar prolongations of middle membrane; gonopores terminal.

Parasites of freshwater and marine fishes of Canada.

Key to Species of *Echinorhynchus*

1 Cement glands arranged linearly along midline 2

Cement glands not arranged linearly 4

2 Roots of apical proboscis hooks more than 75 μm long ..... *E. leidyi* Van Cleave, 1924 (Fig. 10)

Synonyms: *Echinorhynchus salvelini* Linkins in Ward & Whipple, 1918; *Metechinorhynchus leidyi* (Van Cleave, 1924) Golvan, 1969

Description (modified after Van Cleave 1919, 1924, Petrochenko 1956a, Yamaguti 1963, and Golvan 1969): body with anterior region frequently considerably enlarged, especially in females; proboscis (Fig. 10b) cylindrical, armed with 16–18 longitudinal rows of about 13 hooks each; basal hooks 30–50 μm long; median and apical hooks 44–68 μm long, with roots about 83 μm long; lemnisci short, somewhat longer than receptacle.

Males (Fig. 10c): body 7.0–12.0 long, 0.80–2.0 wide; cement glands six, approximately linear, except posterior 2–3 may be grouped.

Females (Fig. 10a): body 10.0–20.0 long, 1.2–2.25 wide; eggs 115–165 μm long, 20–25 μm wide, with polar prolongations of middle membrane; prolongations more than twice longer than wide.

Site: intestine

Hosts: *Catostomus catostomus* (6); *C. commersoni* (6); *Coregonus artedii* (9, 10); *C. autumnalis* (10); *C. clupeaformis* (7); *C. hoyi* (6 (as *Leucichthys hoyi*), 9, 10); *C. sardinella* (10); *Esox lucius* (9, 10, 11); *Lota lota* (6, 10); *Salmo gairdneri* (6, 7 exp.); *Salvelinus alpinus* (8, 10); *S. malma* (1); *S. namaycush* (1 (as *Cristivomer namaycush*), 2, 3, 4, 5, 6, 7).

Records: 1. Van Cleave 1920 (Ont); 2. Cooper 1921 (NWT); 3. Richardson 1942 (Que); 4. Miller 1946a (NWT); 5. Miller and Kennedy 1948 (NWT); 6. Bangham 1955 (Ont); 7. Prychitko and Nero 1983 (Ont, exp); 8. Curtis 1982 (NWT); 9. Shostak and Dick 1982 (Man); 10. Shostak et al. 1986 (Man, NWT); 11. Shostak and Dick 1986 (Man).

Roots of apical proboscis hooks less than 50 μm long 3

3 Roots of apical proboscis hooks more than 35 μm long ..... *E. gadi* Zoega in Müller, 1776 (Fig. 11)

Synonyms: *Echinorhynchus* sp. *sensu* Arai 1967, 1969 part.; *E. ekbaumi* Golvan, 1969; *E. vancleavei* Golvan, 1969

Description (modified after Van Cleave 1924, Petrochenko 1956a, Yamaguti 1963, and Golvan 1969): body filiform, cylindrical, enlarged anteriorly especially in females, attenuating gradually posteriorly, curved ventrad, frequently with transverse annulations; hypodermal nuclei small, numerous; lacunar system well-developed; proboscis (Fig. 11b) cylindrical, almost truncate anteriorly, moderately incurved ventrally, armed with 18–22 longitudinal rows of 10–15 hooks each; proboscis receptacle cylindrical, slightly enlarged posteriorly.

Males (Fig. 11c): body 8.0–20.0 long, 0.6–0.8 wide; proboscis 0.50–0.64 long, 0.20–0.25 wide; proboscis hooks approximately uniform; anterior 10–11 hooks 45–48 μm long, 10 μm wide, roots 43–45 μm long, 10 mm wide; basal 2 hooks without roots, 29–35 μm long, 3–6 μm wide; neck short, 0.15 long; proboscis receptacle sacciform, 1.49–2.0 long, 0.3 wide; lemnisci very delicate, 1.13–1.33 long; testes ovoid to elongate, tandem, not contiguous, in anterior half of trunk, 0.60–1.05 long, 0.2–0.4 wide, about 0.4 apart; cement glands six, oblong, arranged linearly, 280 μm long, 220–240 μm wide, along mid-line, near posterior end of body; seminal vesicle subspherical, 0.20 in diameter; organ of Saefftigen subcylindrical.

Females (Fig. 11a): body 35–80 long, 0.6–1.5 wide at level of base of proboscis receptacle; proboscis 0.67 long, 0.3 wide, armature as in males; some hooks slightly larger than in males, 61–84 μm long; lemnisci slightly longer than in males, about 1.5 long; eggs elongate, fusiform, 70–100 μm long, 13–20 μm wide, with polar prolongations of middle membrane.

Site: intestine

Hosts: *Acipenser oxyrhynchus* (22); *Agonus acipenserinus* (13, 14); *Ammodytes hexapterus* (14); *Anarhichas lupus* (19); *Aprodon cortezianus* (13, 14); *Clupea harengus* (38); *C. harengus pallasi* (23); *Coregonus clupeaformis* (43); *Coryphaenoides rupestris* (26 (as *Macrourus rupestris*)); *Cymatogaster aggregata* (13, 14); *Gadus macrocephalus* (12); *G. morhua* (1 (as *G. callarias*), 2 (as *G. callarias*), 19, 20, 33); *G. ogac* (43); *Glyptocephalus cynoglossus* (10, 24); *Hemilepidotus hemilepidotus* (14); *Hippoglossoides platessoides* (10, 19, 24, 42); *Hippoglossus hippoglossus* (10, 19, 24); *Icelinus filamentosus* (13, 14); *Leptocottus armatus* (14); *Limanda ferruginea* (10, 20); *Liopsetta putnami* (10); *Mallotus villosus* (36); *Macrourus berglax* (19, 31); *Macrozoarces americanus* (6); *Melanogrammus aeglefinus* (4, 5, 20, 30); *Merluccius productus* (34); *Microgadus proximus* (1); *M. tomcod* (4, 7); *Morone saxatilis* (41); *Myoxocephalus*

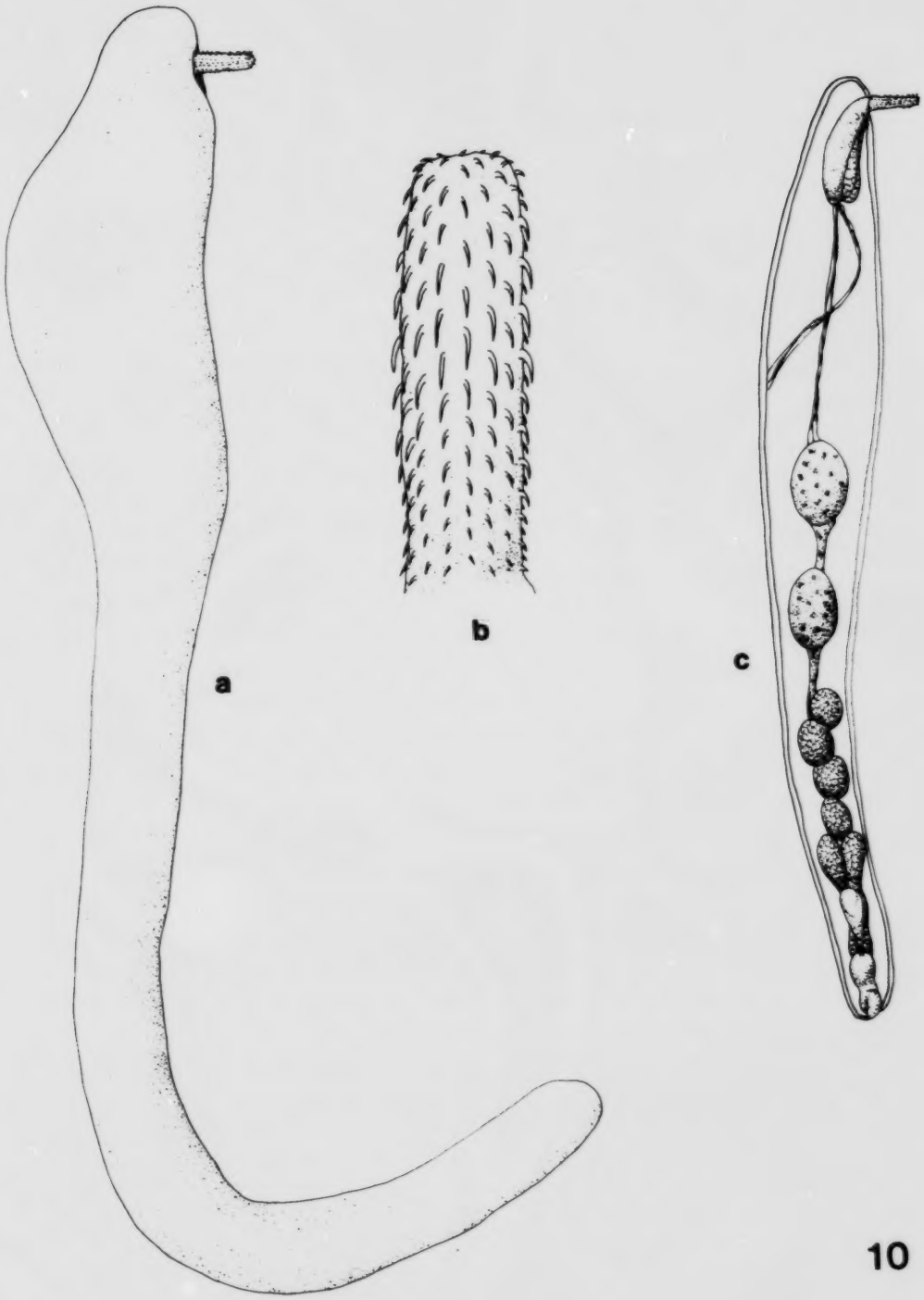

FIG. 10. *Echinorhynchus leidyi* [all redrawn after Golvan (1969)]: (a) surficial aspect of female; (b) proboscis; (c) male.

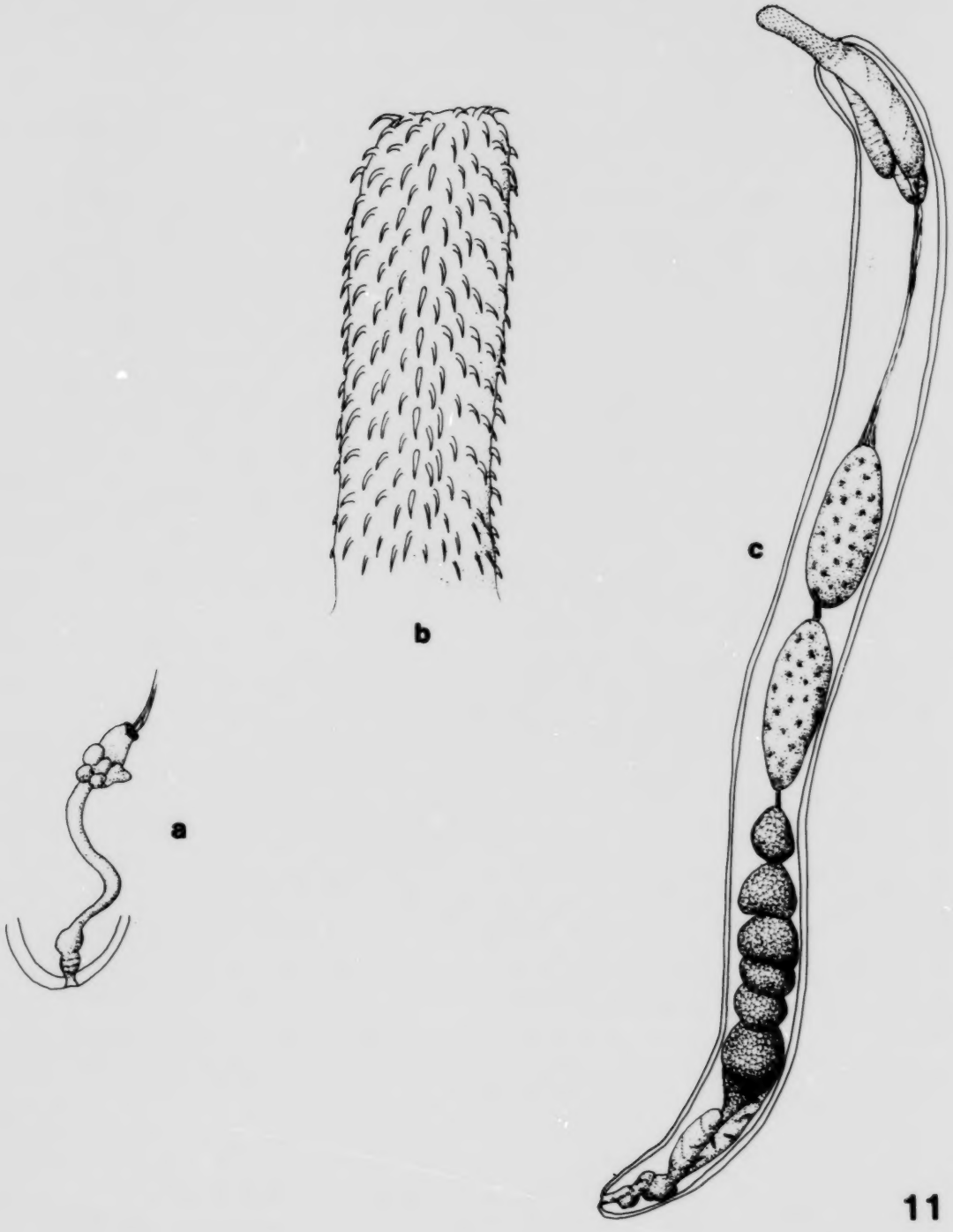

FIG. 11. *Echinorhynchus gadi* [all redrawn after Golvan (1969)]: (a) terminal portion of female genitalia; (b) proboscis; (c) male.

polycanthocephalus (13, 14); *M quadricornis* (17); *Nezumia bairdi* (31); *Oncorhynchus gorbuscha* (3, 5, 8, 9); *O. keta* (3, 5, 13); *O. kisutch* (3, 5, 13, 14); *O. nerka* (3, 5, 8, 11, 13); *O. tshawytscha* (3, 5, 13, 14); *Platichthys stellatus* (13, 14); *Pollachius virens* (5, 39); *Pseudopleuronectes americanus* (10); *Raja radiata* (19); *Reinhardtius hippoglossoides* (19, 29); *Salmo salar* (15, 18, 25); *Salvelinus alpinus* (18, 27, 40, 43); *S. fontinalis* (4, 18, 28); *S. malma* (13, 14); *S. namaycush* (43); *Scophthalmus aquosus* (10); *Sebastes aleutianus* (21), *S. alutus* (21); *S. babcocki* (21); *S. borealis* (21); *S. caurinus* (21); *S. diploprora* (21); *S. flavidus* (21); *S. helvomaculatus* (21); *S. proriger* (21); *S. ruberrimus* (21); *S. zacentrus* (21); *Tautogolabrus adspersus* (2, 16); *Theragra chalcogramma* (13, 35, 37).

Records: 1. Van Cleave 1920 (W Arc); 2. Johansen 1925 (Atl); 3. Kuitunen-Ekbaum 1937a (Pac); 4. Kuitunen-Ekbaum 1937b (Atl); 5. Ekbaum 1938 (Pac); 6. Nigrelli 1946 (Atl); 7. Heller 1949 (Atl); 8. Margolis 1956 (Pac); 9. 1957 (Pac, BC); 10. Ronald 1963 (Atl); 11. Margolis 1963 (Pac); 12. 1965 (Pac); 13. Arai 1967 (Pac); 14. 1969 (Pac); 15. Pippy 1969 (NB, NS); 16. Sekhar and Threlfall 1970 (Atl); 17. Threlfall and Hanek 1971 (Lab); 18. Hanek and Molnar 1974 (Que); 19. Redkozubova 1976 (Atl); 20. Gaevskaya and Umnova 1977 (Atl); 21. Sekerak and Arai 1977 (Pac); 22. Appy and Dadswell 1978 (Atl); 23. Arthur and Arai 1980a (Pac); 24. Zubchenko 1980 (E Arc); 25. Pippy 1980 (NB, NS, Nfld, Atl); 26. Szuks 1980 (E Arc); 27. Dick and Belosevic 1981 (NWT); 28. Black 1981 (Que); 29. Reimer 1981 (E Arc); 30. Scott 1981 (Atl); 31. Zubchenko 1981 (Atl); 32. Appy and Burt 1982 (Atl); 33. Khan and Kiceniuk 1983 (Atl); 34. Sankurathri et al. 1983 (Pac); 35. Arthur 1984 (Pac); 36. Pálsson and Beverley-Burton 1984 (Atl); 37. Kabata and Whitaker 1984 (Pac); 38. McGladdery and Burt 1985 (Atl); 39. Scott 1985 (Atl); 40. Dick 1984 (NWT); 41. Hogans 1984 (NB); 42. Zubchenko 1985 (Atl); 43. Shostak et al. 1986 (W Arc, E Arc, Man).

Remarks: The records of Appy and Dadswell (1978) and of Black (1981) were reported as *Echinorhynchus "gadi"* complex and that of Appy and Burt (1982) as *Echinorhynchus vancleavei*. The locality for *Macrozoarces americanus* by Nigrelli (1946) was indicated as 'several areas along the North Atlantic'.

Roots of apical proboscis hooks less than 30 μm long 5

4 Trunk of body attenuated posteriorly ..... *E. salmonis* Müller, 1784 (Fig. 12)

Synonyms: *Echinorhynchus coregoni* Linkins in Van Cleave, 1919; *Metechinorhynchus salmonis* (Müller, 1784) Petrochenko, 1956

Description (modified after Van Cleave 1919, Petrochenko 1956a, Yamaguti 1963, and Golvan 1969): body fusiform, robust, enlarged anteriorly; proboscis (Fig. 12b) subcylindrical, slightly enlarged in middle region, obliquely inclined forming an obtuse angle with longitudinal axis of body, armed with 12–16 longitudinal rows of 9–11 hooks each; basal 3–4 hooks and apical hooks very small; hooks showing dorsoventral asymmetry, with ventral hooks longer and stouter; lemnisci shorter than receptacle; neck very short.

Males (Fig. 12c): body 3.0–6.3 long, 0.8–1.60 wide anteriorly, 0.6–0.7 wide posteriorly; proboscis 0.7–1.0 long, 0.25–0.37 wide; hooks of middle region largest; apical 7–8 hooks small, with roots; posterior 3–4 hooks without roots, very small, 28–53 μm long; middle hooks 65–87 μm long, 10–13 μm wide with roots 56–68 μm long, 13 μm wide; neck 0.25 long; proboscis receptacle sacciform, 1.36–1.64 long, 0.31 wide; lemnisci flagellate, 0.94–1.0 long; testes irregularly ovoid, 0.52–0.63 long, 0.47 wide, tandem, in middle third of trunk; cement glands six, rounded, compactly grouped just posterior to testes.

Females (Fig. 12a): body 3.0–8.0 long, 0.6–1.8 wide, attenuated posteriorly; proboscis 1.04–1.16 long, 0.34–0.37 wide; proboscis armature as in males, slightly larger, with 7–8 apical hooks 107–113 μm long; receptacle 2.0–2.3 long; lemnisci as in males; eggs fusiform, 51–95 μm long, 17–25 μm wide, with polar prolongations of the middle membrane.

Site: intestine

Hosts: *Acipenser fulvescens* (9); *Alosa pseudoharengus* (16, 22); *Ambloplites rupestris* (9); *Catostomus catostomus* (9, 19, 20, 26); *C. commersoni* (8, 9, 16, 19, 20, 22, 26); *Coregonus alpenae* (9 (as *Leucichthys alpenae*)); *C. artedii* (9 (as *Leucichthys artedii*), 14, 15, 17, 18, 19, 20, 21, 22, 24, 26); *C. clupeaformis* (3, 7, 8, 9, 14, 15, 16, 17, 18, 19, 20,

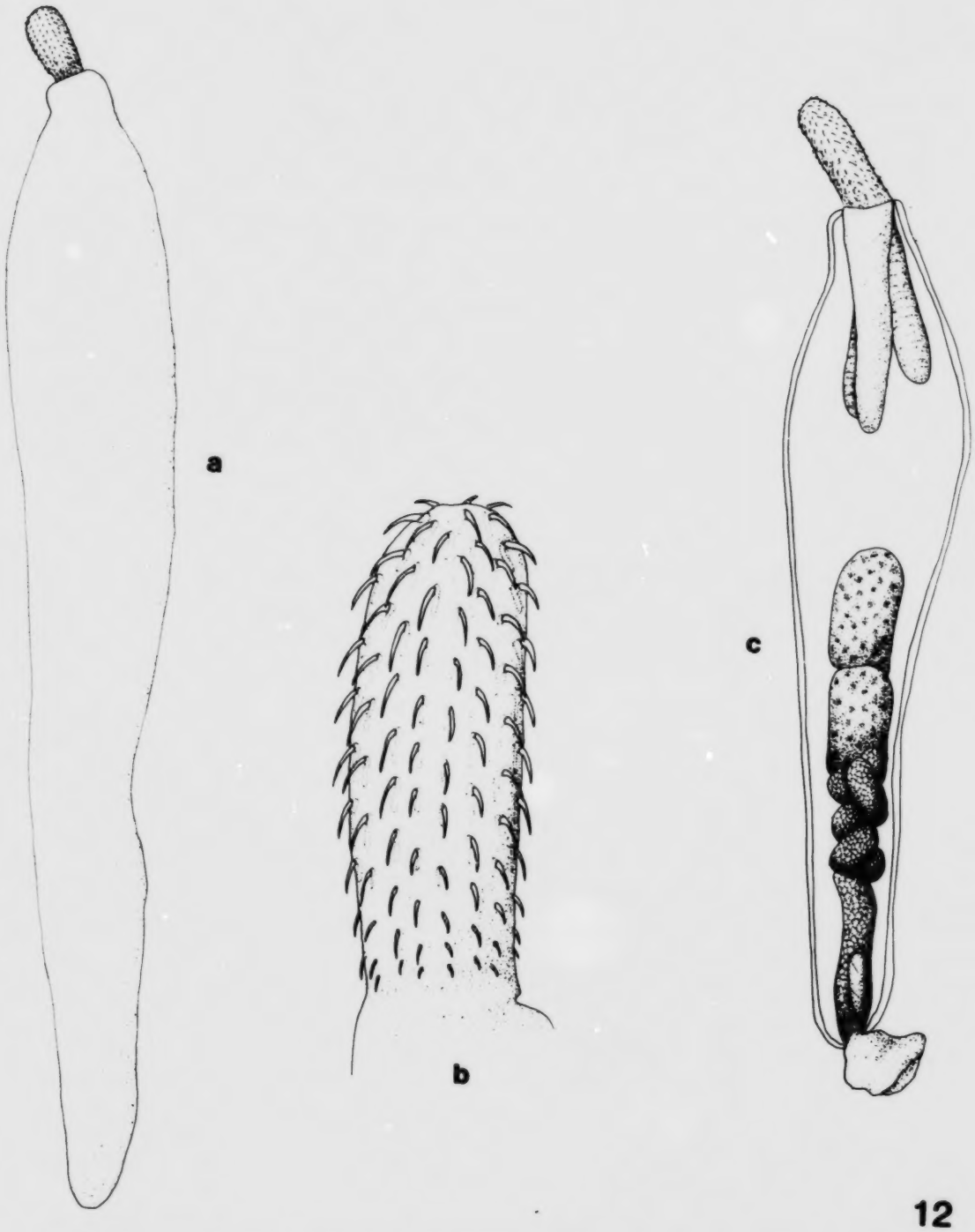

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FIG. 12. *Echinorhynchus salmonis* (a) surficial aspect of female [redrawn after Van Cleave (1919)]; (b) proboscis [redrawn after Meyer (1932)]; (c) male [redrawn after Golvan (1969)].

21, 22, 24, 26, 28); *C. hoyi* (9 (as *Leucichthys hoyi*), 22); *C. sardinella* (30); *Coregonus* sp. (6); *Cottus bairdi* (15); *Couesius plumbeus* (9); *Esox lucius* (28); *Esox masquinongy* (15). *Ictalurus nebulosus* (15); *Lepomis gibbosus* (9); *Lota lota* (3 (as *Lota maculosa*), 9 (as *Lota maculosa*), 15, 18, 19, 20, 26, 28); *Micropterus dolomieui* (9); *M. salmoides* (9 (as *Huro salmoides*)); *Myoxocephalus quadricornis* (9 (as *Triglopsis thompsoni*)); *Notropis hudsonius* (9); *Oncorhynchus kisutch* (17, 18, 19, 20, 23, 26); *O. nerka* (16); *O. tshawytscha* (23); *Osmerus mordax* (9, 14, 16, 22, 27); *Perca flavescens* (9, 11, 12 (as *Perca fluviatilis*), 13 (as *Perca fluviatilis*), 16, 22); *Percopsis omiscomaycus* (9, 16); *Petromyzon marinus* (9, 10); *Prosopium cylindraceum* (9); *Pungitius pungitius* (17, 18, 19, 20, 26); *Salmo gairdneri* (9); *Salvelinus alpinus* (1 (as *Salvelinus oquassa marstoni*), 2, 29); *S. fontinalis* × *S. namaycush* (16, 22); *S. malma* (1); *S. namaycush* (1 (as *Cristivomer namaycush*), 2, 5, 8, 9, 14, 15, 17, 18, 19, 20, 26, 28, 30); *Stizostedion canadense* (9, 15); *S. vitreum vitreum* (15, 19, 20, 26); *Thymallus arcticus* (4); unspecified salmonids (17).

Records: 1. Van Cleave 1920 (NWT); 2. Cooper 1921 (NWT); 3. Bangham and Hunter 1939 (Ont); 4. Miller 1964b (NWT); 5. Miller and Kennedy 1948 (NWT); 6. Rawson 1951 (NWT); 7. Stewart-Hay 1953a (Man); 8. 1953c (Man); 9. Bangham 1955 (Ont); 10. Wilson and Ronald 1967 (Ont); 11. Tedla and Fernando 1969 (Ont); 12. 1970 (Ont); 13. 1972 (Ont); 14. Dechtiar 1972a (Ont); 15. 1972b (Ont); 16. Collins and Dechtiar 1974 (Ont); 17. Leong and Holmes 1974a (Alta); 18. 1974b (Alta); 19. Leong 1975 (Alta); 20. Holmes et al. 1977 (Alta); 21. Watson 1977 (Man); 22. Dechtiar and Berst 1978 (Ont); 23. Lester and Wright 1978 (Ont); 24. Watson and Dick 1979 (Man); 25. 1980 (Man); 26. Leong and Holmes 1981 (Alta); 27. Fréchet et al. 1983 (Que, Atl); 28. McAllister and Mudry 1983 (Alta); 29. Curtis 1984 (NWT, Que); 30. Shostak et al. 1986 (NWT).

Trunk of body enlarged posteriorly ..... *E. lageniformis* Ekbaum, 1938 (Fig. 13)

Synonym: *Metechinorhynchus lageniformis* (Ekbaum, 1938) Petrochenko, 1956

Description (modified after Ekbaum 1938, Petrochenko 1956a, Yamaguti 1963, Golvan 1969, and Olson and Pratt 1971): body small, aspinose, with sexual dimorphism well-marked; hypodermis with numerous fragments of giant nuclei; proboscis (Fig. 13b) cylindrical or slightly enlarged at mid-level, 0.25–0.423 long, 0.155–0.179 wide, armed with 14–16 longitudinal rows of 8–10 hooks each; apical hooks 40–55 μm long; median hooks 48–69 μm long; basal hooks 35–46 μm long; neck short, conical; proboscis receptacle 0.564–1.2 long, 0.141–0.179 wide, with ganglion at mid-level; uncontracted lemnisci slightly longer than receptacle.

Males (Fig. 13a): body 1.5–5.0 long, 0.485–1.014 wide; testes two, ovate, tandem or obliquely positioned, 0.282–0.50 long, 0.136–0.35 wide; cement glands six, pyriform, 0.20–0.25 long, 0.10–0.15 wide, grouped together.

Females (Fig. 13c): body bulbous, 1.69–6.5 long, 0.676–2.2 wide; proboscis 0.376–0.494 long, 0.165–0.235 wide; proboscis receptacle 0.494–0.776 long, 0.132–0.226 wide; vagina 30–35 μm long; uterus 0.232–0.276 long; eggs 55–70 μm long, 12–20 μm wide.

Site: intestine

Hosts: *Lepidopsetta bilineata* (1, 2); *Platichthys stellatus* (1, 2, 3).

Records: 1. Kuitunen-Ekbaum 1937a (Pac); 2. Ekbaum 1938 (Pac); 3. Prakash and Adams 1967 (Pac).

5 Lemnisci from one-half to three-quarters length of proboscis receptacle ..... *E. lateralis* Leidy, 1851 (Fig. 14)

Synonyms: *Acanthocephalus lateralis* (Leidy, 1851) Petrochenko, 1956; *Metechinorhynchus lateralis* (Leidy, 1851) Golvan, 1969a.

Description (modified after Leidy 1851, Van Cleave 1924, Richardson 1936, and Golvan 1969): body cylindrical, bluntly rounded at both ends, slightly enlarged anteriorly in females; proboscis (Fig. 14b) cylindrical, 0.7–0.75 long, obliquely inclined or perpendicular to longitudinal axis of trunk, armed with 12-18 longitudinal rows of 10–12 hooks each; apical hooks 25–27 μm long; median hooks 25–58 μm long; basal hooks 23–55 μm long; all hooks with roots equal in length to that of blade; proboscis receptacle 0.464–1.38 long; lemnisci from one-half to three-quarters length of receptacle.

Males (Fig. 14c): body 2.0–17.5 long, 0.4–1.6 wide anteriorly, 0.5–0.6 wide posteriorly; testes rarely

FIG. 13. *Echinorhynchus lageniformis* [all redrawn after Ekbaum (1938)]: (a) male; (b) proboscis; (c) surficial aspect of female.

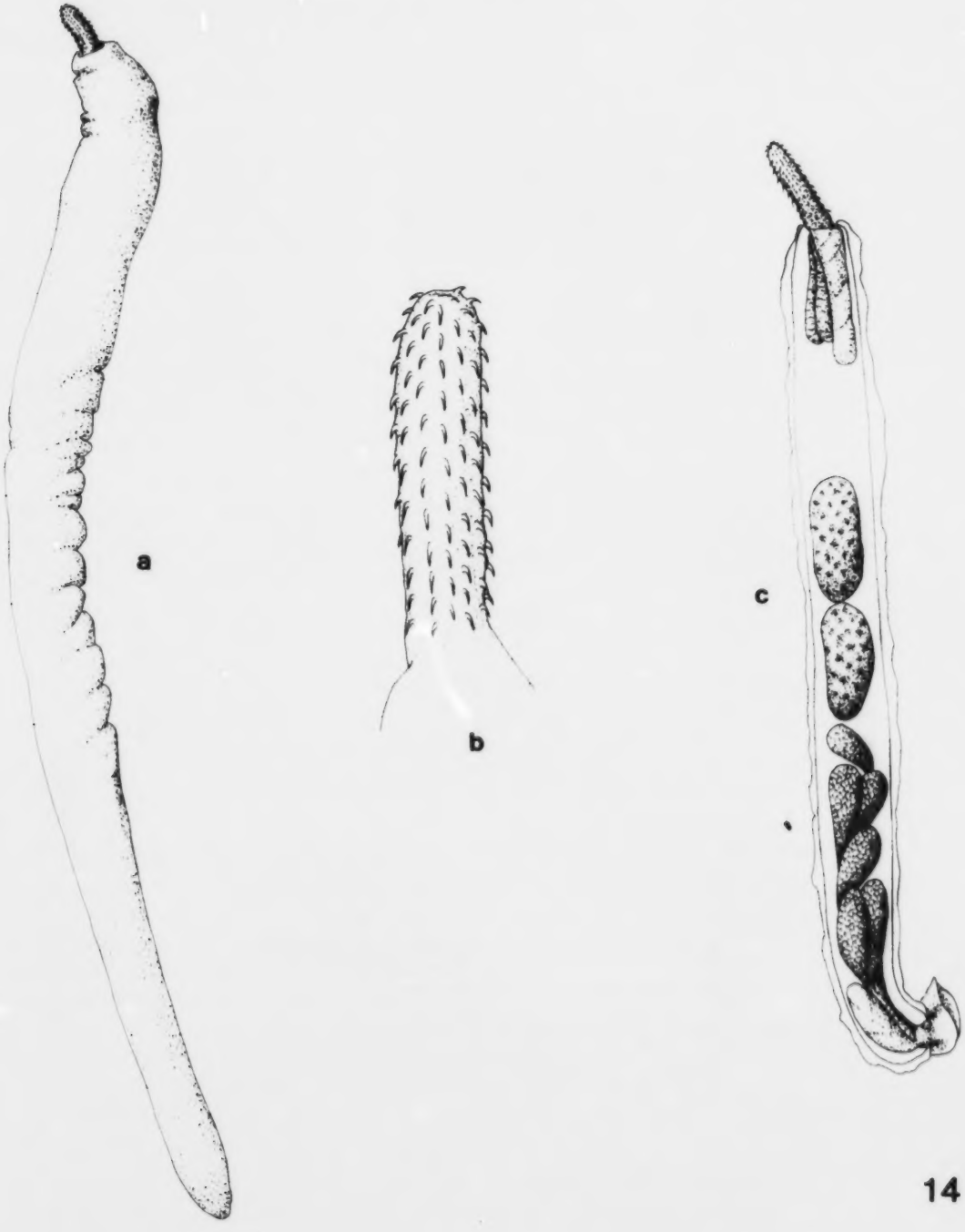

FIG. 14. *Echinorhynchus lateralis* [all redrawn after Richardson (1936)]: (a) surficial aspect of female; (b) proboscis; (c) male.

contiguous, subequal, 0.295–1.68 long, 0.118–0.97 wide; anterior testis usually larger; cement glands six, pyriform, linearly arranged, but variable; common pattern of cement glands; first single, second and third paired, fourth single, fifth and sixth paired; anterior-most gland rarely contiguous with posterior testis.

Females (Fig. 14a): body 10.0–14.0 long, 1.0 wide anteriorly, 0.75 wide posteriorly; eggs 65–112 μm long, 20 μm wide, with polar prolongations of middle membrane; prolongations clearly longer than wide.

Site: intestine

Hosts: *Ambloplites rupestris* (3); *Anguilla rostrata* (10); *Catostomus commersoni* (3); *Coregonus artedii* (11); *C. clupeaformis* (4, 6, 11, 12, 13); *Esox lucius* (7, 11, 19); *Gasterosteus aculeatus* (8, 22); *Micropterus dolomieui* (3); *Osmerus mordax* (11, 21); *Perca flavescens* (3); *Prosopium cylindraceum* (13); *Pungitius pungitius* (9); *Salmo gairdneri* (4); *S. salar* (4, 11, 13, 15, 16, 17, 22); *S. trutta* (4, 6); *Salvelinus alpinus* (13); *S. fontinalis* (1, 2, 3, 4, 5, 6, 13, 14, 16, 18, 19, 20, 22); *S. namaycush* (13)

Records: 1. Richardson 1936 (Que); 2. Choquette 1948 (Que); 2. Fantham and Porter 1948 (Que); 4. Sandeman and Pippy 1967 (Nfld); Pippy and Sandeman 1967 (Nfld); 6. Threlfall and Hanek 1970a (Nfld); 7. 1970b (Lab); 8. Hanek and Threlfall 1970a (Nfld, Lab); 9. 1970b (Nfld); 10. 1970c (Nfld, Lab); 11. Dechtiar 1972a (Ont); 12. 1972b (Ont); 13. Hicks and Threlfall 1973 (Lab); 14. Hare and Frantsi 1974 (NB); 15. Hare and Burt 1975a (NB); 16. Frantsi et al. 1975 (NB); 17. Hare and Burt 1976 (NB); 18. Thompson and Threlfall 1978 (Que); 19. Chinniah and Threlfall 1978 (Lab); 20. Black 1981 (Que); 21. Threlfall 1981 (Nfld); 22. Cone and Ryan 1984 (Nfld).

Lemnisci as long or longer than proboscis receptacle ... *E. laurentianus* Ronald, 1957 (Fig. 15)

Description (modified after Ronald 1957, Yamaguti 1963, and Golvan 1969): body curved with proboscis at an angle to longitudinal axis of trunk; sexual dimorphism well-marked, females larger than males; proboscis (Fig. 15a) armed with 14–16 longitudinal rows of 11–13 hooks each; larger hooks 38–48 μm long, with roots 24–29 μm long; hooks curved, conical; basal hooks small, triangular.

Males (Fig. 15b): body generally less curved than in females, 5.0–11.0 long, 0.55–0.72 wide; proboscis similar to that of female in armature and form; testes two, tandem, bluntly ellipsoidal, 0.60–0.95 long, 0.28–0.35 wide; ligament present between testes; sperm duct leaving posterior end of each testis, twisted together, uniting before entering copulatory apparatus; cement glands six, super-imposed, each roughly globular, arranged linearly; cement ducts emptying into common sperm duct; copulatory bursa reniform when everted, closely folded when extroverted; gonopore dorsomedial.

Females: body 10.0–15.0 long, 0.80–1.40 wide, curved ventrad giving proboscis appearance of inserting on ventral surface; proboscis 0.35–0.36 long, 0.11–0.15 wide; larger hooks 38–48 μm long, 20–25 μm wide, with roots 24–29 μm long; basal hooks small, triangular; apical hooks curved, conical; lemnisci broadly elongate, on each side of receptacle, 0.80–1.10 long, 0.18–0.32 wide; proboscis receptacle tubular, 0.55–0.75 long, 0.32–0.40 wide, with ganglion in posterior region, with two retinacula passing posteriad from posterior region of ganglion, 1.0 long; root of dorsal retractor triradiate; root of ventral retractor weakly biradiate; eggs with one end pointed, other end stalked with terminal bulb.

Site: intestine.

Hosts: *Glyptocephalus cynoglossus* (3); *Hippoglossoides platessoides* (1, 2, 3); *Hippoglossus hippoglossus* (1, 2, 3); *Limanda ferruginea* (3); *Liopsetta putnami* (3); *Pseudopleuronectes americanus* (1, 2); *Reinhardtius hippoglossoides* (3); *Scophthalmus aquosus* (1, 2).

Records: 1. Ronald 1957 (Atl); 2. 1963 (Atl); 3. Redkozubova 1978 (Atl)

Remarks: Hosts attributed to Redkozubova (1978) were not specifically named but *E. laurentianus* was said to have been harbored by all species of flounders examined.

Echinorhynchus sp.

Sites: intestine, stomach

Hosts: *Acipenser oxyrhynchus* (8); *Coregonus clupeaformis* (3, 4); *C. reighardi* (2 (as *Leucichthys reighardi*)); *Etheostoma exile* (4 (as *Poecilichthys exilis*)); *Gadus morhua* (11); *Gaidropsaurus ensis* (14); *Lycodonus mirabilis* (14); *Macrourus berglax* (14); *Macrozoarces americanus* (1 (as *Zoarces anguillaris*)); *Nezumia bairdi* (14); *Osmerus mordax* (10); *Percina caprodes* (4); *Salmo salar* (6, 9); *Salvelinus alpinus* (12, 13); *S. fontinalis* (5); *Stizostedion vitreum glaucum* (4(as *S. glaucum*)); *S. vitreum vitreum* (4); unspecified fishes (7).

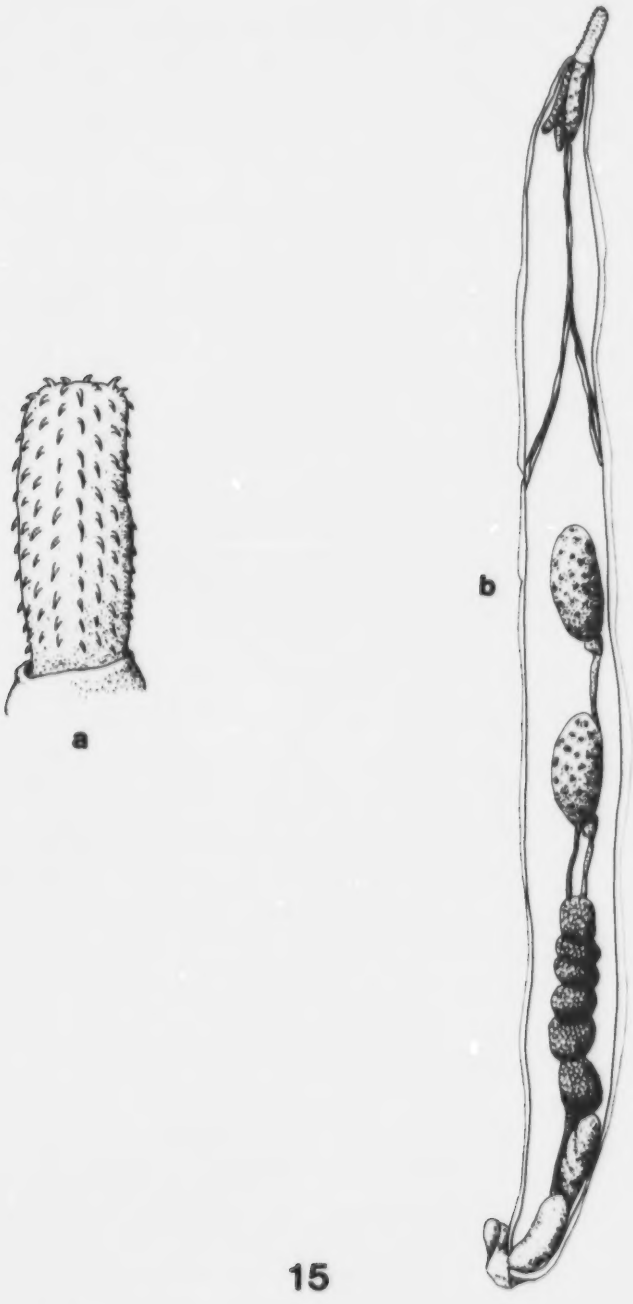

FIG. 15. *Echinorhynchus laurentianus* [both redrawn after Ronald (1957)]: (a) proboscis; (b) male.

Records: 1. Clemens and Clemens 1921 (Atl); 2. Pritchard 1931 (Ont); 3. Hart 1931 (Ont); 4. Bangham and Hunter 1939 (Ont); 5. Munroe 1949 (Que, Lab); 6. Pippy 1969 (Atl); 7. Redkozubova 1976 (Atl); 8. Appy and Dadswell 1978 (NB); 9. Pippy 1980 (NB, NS, Nfld, Lab, Atl); 10. Threlfall 1981 (Nfld); 11. Appy and Burt 1982 (Atl); 12. Curtis and Stenzel 1984 (Que); 13. Dick 1984 (NWT): 14. Houston and Haedrich 1986 (Atl).

Order Polymorphida Petrochenko, 1956

General characters (modified after Petrochenko 1956b and Amin 1982): body usually spinose; proboscis spheroid to cylindrical, with numerous hooks in alternating longitudinal rows, often different in size, either along length of proboscis or on ventral and dorsal surfaces; proboscis receptacle with ganglion near mid-level, double-walled; cement glands multiple, long, pyriform or tubular; hypodermis with numerous small fragments of giant nuclei; eggs elongate, fusiform, with polar prolongations of middle membrane.

One family with juveniles in marine fishes of Canada.

Polymorphidae Meyer, 1931

General characters (modified after Golvan 1960a, Yamaguti 1963, and Amin 1982): body small to medium size; trunk spinose anteriorly in both sexes, or at least in males, bulbous or not; sexual dimorphism may be marked; proboscis subcylindrical, rather short, sometimes bulbous, often with specialized hooks in middle part of ventral rows; hypodermis with numerous fragments of giant nuclei; neck distinct, may be long and slender; proboscis receptacle double-walled, with ganglion near mid-level; lemnisci generally longer than wide, often flattened, leaf-shaped; usually with 2–6 cement glands, exceptionally with eight, tubular but also reniform or pyriform; eggs with or without polar prolongations of middle membrane.

Juveniles of species of two genera reported from fishes of Canada.

Key to Genera of Polymorphidae

Spines present around or near gonopore, at least in males; cement glands 4–6, pyriform to claviform ..... *Corynosoma*

Genital spines lacking in both sexes; cement glands 2, tubular, long ..... *Bolbosoma*

Corynosoma Lühe, 1904

Diagnosis (modified after Petrochenko 1956b, Golvan 1960a, and Yamaguti 1963): body small to medium size, claviform, enlarged and flattened anteriorly, forming discoid or bulbar swelling, attenuated and cylindrical posteriorly; trunk spined profusely anteriorly, with spination restricted to ventral surface posteriorly; genital spines present in males or in both sexes; hypodermal nuclei small, numerous; main lacunar canals lateral, with reticular anastomoses; proboscis inserted on discoid or bulbar swelling of trunk, inclined ventrad, subcylindrical, slightly enlarged medially, armed with 14–28 longitudinal rows of 8–18 hooks each; stoutest hooks in enlarged region of proboscis; basal hooks with rudimentary roots; proboscis receptacle double-walled, with ganglion near mid-level; lemnisci always shorter than receptacle, lobate; testes rounded, tandem or symmetrical, usually contiguous; cement glands six, pyriform; eggs large, with polar prolongations of middle membrane.

Key to Species of *Corynosoma*

1 Ventral field of trunk spines not extending to gonopore 2

Ventral field of trunk spines extending to vicinity of gonopore 3

2 Proboscis armed with 16 or fewer longitudinal rows of hooks .....
..... *C. wegeneri* Heinze, 1934 (Fig. 16)

Synonym: *Corynosoma hadweni* Van Cleave, 1953

Description (modified after Heinze 1934, Van Cleave 1953a,b, Petrochenko 1956b, Golvan 1959, and Yamaguti 1963): body (Fig. 16a) without conspicuous sexual dimorphism, 4.5–8.5 long, with anterior part enlarged, maximum width 1.02, curved ventrad; anterior portion representing three-eighths of total body length; posterior part cylindrical, 0.25 wide near mid-level, enlarged to 0.35 at posterior extremity; trunk spines present dorsally and ventrally in anterior part, extending more posteriorly along ventral surface, 26–46 μm long, 8–14 μm wide at base; genital spines 24–35 μm long, 10 μm wide at base; proboscis (Fig. 16b) subcylindrical, distinctly enlarged medially, 0.84–0.93 long, 0.30–0.37 wide, armed with 15–16 rows of 10–11 hooks each; hooks in enlarged portion different from others; sixth hook in each row largest; first six hooks in each row with distinctly discernable roots, with root equal in length to that of blade; basal 4–5 hooks in each row much smaller, with greatly reduced roots; testes two, elongate, in anterior part of trunk two times longer than wide; eggs 91–115 μm long, 20–35 μm wide, with middle membrane forming polar prolongations.

Site: mesenteries

Hosts: *Atheresthes stomias* (3); *Gadus morhua* (2); *Pseudopleuronectes americanus* (1).

Records: 1. Montreuil 1955 (Atl); 2. Appy and Burt 1982 (Atl); 3. Kabata and Whitaker 1984 (Pac).

Proboscis armed with 17 or more longitudinal rows of hooks .....
..... *C. magdaleni* Montreuil, 1958 (Fig. 17)

Description (modified after Montreuil 1958 and Yamaguti 1963): body with long, slender hind-trunk and enlarged fore-trunk; hind-trunk nearly twice length of fore-trunk; fore-trunk nearly twice width of hind-trunk; neck short, conical but truncated, inclined from longitudinal axis of trunk; proboscis (Fig. 17b) vase-shaped, enlarged in basal third, armed with 17–23 longitudinal rows of 9–11 hooks each; apical 6–7 hooks with strong, recurved roots longer than blade; basal 4–5 hooks small, closely crowded, separated from anterior series, with roots of inverted "Y" form; leg of "Y" directed anteriorly, up to twice as long as width of blade; two posteriorly directed branches equal to or slightly longer than width of blade; largest hooks 50–60 μm long, 19–23 μm wide; anterior hooks of basal series 23–26 μm long, 8–14 μm wide; field of trunk spines extending short distance dorsally, covering fore-trunk and extending posteriorly along ventral surface to near mid-level of hind-trunk; trunk spines usually sigmoidal, 25–30 μm long; proboscis receptacle double-walled, muscular, with small ganglion at or near mid-level; lemnisci broad, leaf-shaped, always shorter than receptacle.

Males (Fig. 17a, c): body averaging 4.2 in length; fore-trunk 0.80–1.0 wide; hind-trunk 0.43–0.45 in maximum width, 0.35–0.37 in minimum width; neck 0.30–0.35 in width at base, 0.14–0.16 in width at apex, 0.14–0.19 long; genital spines numerous, covering entire circumference of posterior end, extending anteriorly approximately one-half distance to level of maximum width of hind-trunk; proboscis receptacle 0.60–0.65 long; testes ellipsoidal, 1.5 times longer than wide, shape variable, 0.32–0.43 long; cement glands long, narrow, grouped in triads, each triad contiguous with respective testis; Saefftigen's pouch about 0.80 long.

Females (Fig. 17d): body averaging 4.5; fore-trunk 0.90–1.2 wide; hind-trunk with minimum width 0.35–0.37, maximum width 0.43–0.45 μm near posterior extremity; neck 0.14–0.19 long, 0.14–0.18 wide; proboscis 0.44–0.50 long, with maximum width 0.23–0.25 in basal third, 0.16–0.18 more anteriorly; genital spines 2–10 μm long, sometimes absent; proboscis receptacle 0.65–0.70 long; uterus usually distended with shelled embryos posterior to uterine bell, walls thickening posteriorly forming thin tube 0.35–0.40 long, 25–60 μm wide; uterine sphincter constricted medially, resulting in squat, hourglass shape, 85–100 μm wide; vagina 45–70 μm long, 55–60 μm wide; gonopore subterminal, dorsal; eggs 75–90 μm long, 25 μm wide, with polar prolongations of middle membrane.

Site: intestine

Hosts: *Hippoglossus hippoglossus; Myoxocephalus scorpius.*

Record: Montreuil 1958 (Atl).

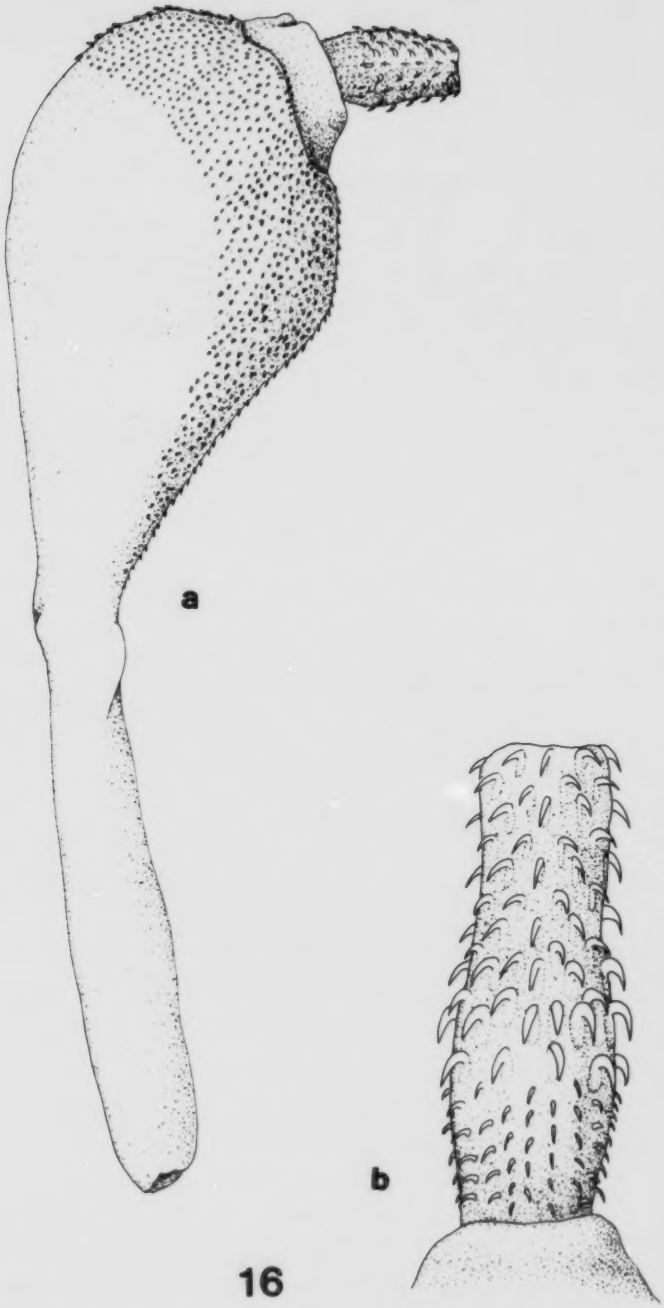

FIG. 16. *Corynosoma wegeneri* [both redrawn after Van Cleave (1953a)]: (a) male showing trunk spination; (b) proboscis.

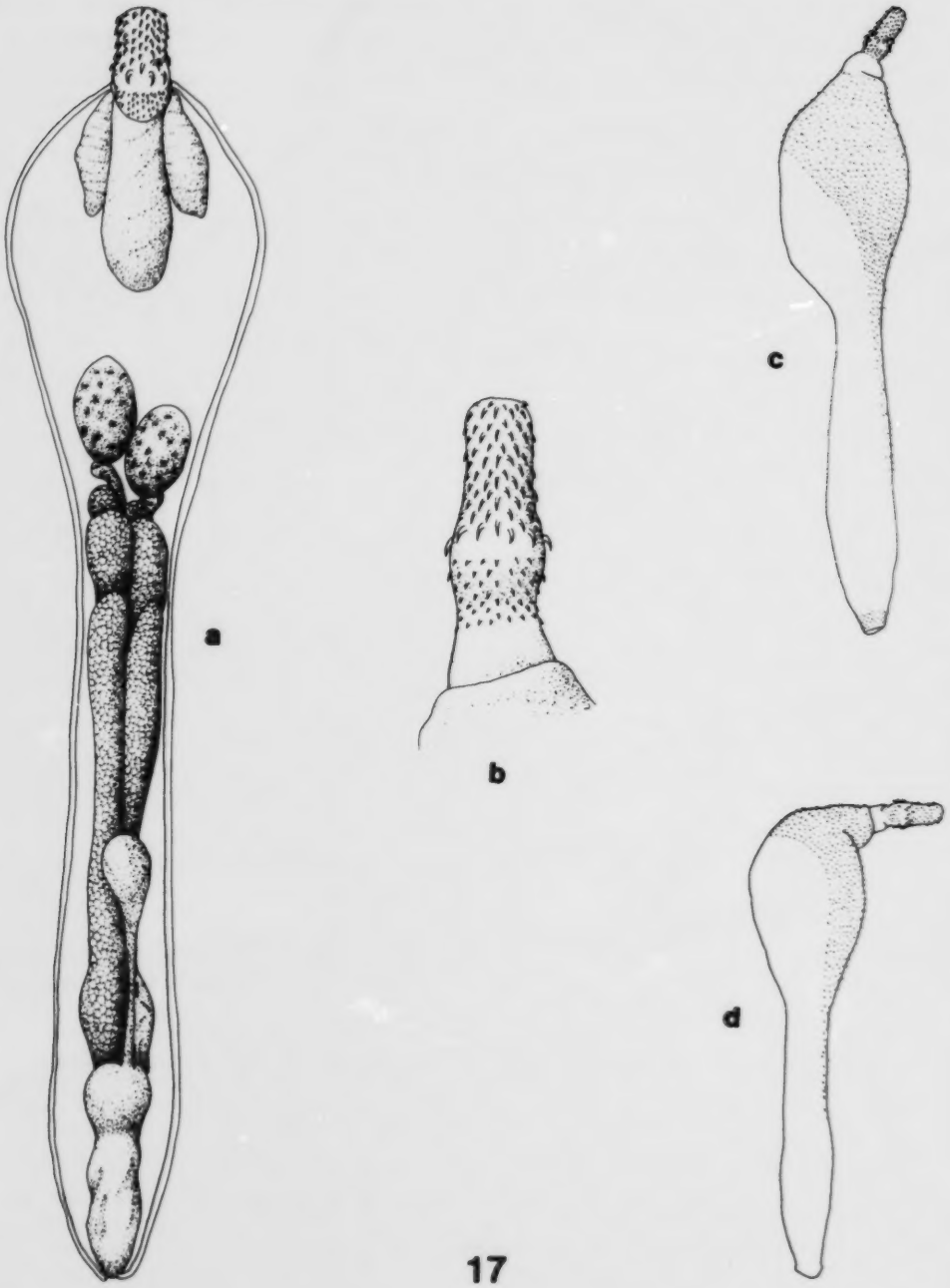

FIG. 17. *Corynosoma magdaleni* [all redrawn after Montreuil (1958)]: (a) male; (b) proboscis; (c) male showing trunk spination; (d) female showing trunk spination.

3 Proboscis armed with less than 20 longitudinal rows of hooks .....
..... *C. strumosum* (Rudolphi, 1802) Lühe, 1904 (Fig. 18)

Description (modified after Van Cleave 1953a, b, Petrochenko 1956b, Golvan 1959a, and Yamaguti 1963): body without conspicuous sexual dimorphism, narrowly attenuated, 5.0–9.0 long; fore-trunk enlarged, about one-fourth to one-third length of entire trunk, usually in form of elongated ellipsoidal enlargement, rarely set off as distinctly flattened disc, often flexed ventrad, somewhat more prominently enlarged dorsally than ventrally; fore-trunk with dorsoventral dimension often reaching 1.0; hind-trunk conspicuously narrower, about one-half width and twice length of fore-trunk, with little variation in width along length except somewhat narrower in region of gonopore, especially in males; trunk spines fairly uniform in length, 22–50 μm long, dispersed over fore-trunk, extending along ventral surface for about one-half length of fore-trunk; genital spines (Fig. 18a, b) around posterior extremity, especially of males, often introverted into genital vestibule, 22–28 μm long, 8–11 μm wide, not in perfect rows, commonly about 6–8 recognizable in longitudinal series, scattered and fewer in females; neck short, truncated, conical; proboscis (Fig. 18c) subcylindrical, with enlarged band at region between middle and basal thirds of length, narrowed somewhat at base, 0.50–0.69 long, 0.20–0.25 wide, armed with 18 longitudinal rows of 10–11 hooks each; apical 5–6 (occasionally 7) of each row provided with strongly recurved roots; basal 4 devoid of roots, closely crowded together; posterior hooks of each rooted series located on or near level of greatest width of proboscis, considerably stouter than others, 64–80 μm long, 26–32 μm wide at junction of blade and root, with root longer than blade; apical hooks progressively decreasing in width, some less recurved, some with straighter, slightly longer blades than stouter hooks; small basal hooks often crescentic in shape, some strongly angular, 32–40 μm long; proboscis receptacle double-walled, sacciform, not extending beyond border of enlarged portion of trunk; lemnisci broad, flat, shorter than receptacle; male organs (Fig. 18d) located in anterior part of cylindrical region of hind-trunk; testes subspherical, contiguous; cement glands six, pyriform, contiguous with testes; eggs 79–101 μm long, 19 μm wide, with small polar prolongations of middle membrane.

Sites: liver, mesenteries, intestinal wall

Hosts: *Acipenser transmontanus* (14); *Clupea harengus pallasi* (8, 9); *Eopsetta jordani* (4); *Lepidopsetta bilineata* (1, 3, 4, 5); *Melanogrammus aeglefinus* (2, 12); *Oncorhynchus gorbuscha* (7); *O. nerka* (6, 7); *Platichthys stellatus* (1, 3, 4); *Reinhardtius hippoglossoides* (10, 11); *Theragra chalcogramma* (13).

Records: 1. Kuitunen-Ekbaum 1937a (Pac); 2. 1937b (Atl); 3. Ekbaum 1938 (Pac); 4. Margolis 1952 (Pac); 5. Montreuil 1955 (Atl); 6. Margolis 1957 (Pac); 7. 1958 (Pac); 8. Arthur and Arai 1980a (Pac); 9. 1980b (Pac); 10. Zubchenko 1980 (Atl); 11. Reimer 1981 (Atl); 12. Scott 1981 (Atl); 13. Arthur 1984 (Pac); 14. Margolis and McDonald 1986 (BC).

Proboscis armed with more than 20 longitudinal rows of hooks 4

4 Spines of ventral surface of anterior portion extend in an uninterrupted band to posterior end
..... *C. semerme* (Forssell, 1904) (Fig. 19)

Description (modified after Van Cleave 1953a,b and Petrochenko 1956b): sexual dimorphism not pronounced; body small but thickset, 3.0–5.0 long, 0.7–1.0 in maximum dorsoventral diameter, gradually reducing to less than one-half of maximum near posterior end; fore-trunk enlarged, ellipsoidal or discoidal; hind-trunk cylindrical, usually not as long as fore-trunk; trunk spines distributed over anterior part of fore-trunk, extending ventrally along length of hind-trunk, becoming continuous with genital spines in males (Fig. 19a); ventral spines often emerging from rounded, elevated papillae, usually sigmoidal in shape, largest 35–53 μm long, 8–14 μm wide; neck short, not prominent, often retracted into fore-trunk, surrounding base of proboscis; proboscis (Fig. 19c) subcylindrical, with slight enlargement at level between basal and middle thirds, 0.50–0.60 long, 0.20–0.30 wide, usually curved ventrad, armed with 22–24 longitudinal rows of 12–13 hooks each; apical 7–9 hooks with recurved roots of about same length as blade, becoming progressively larger posteriorly, with 7th or 8th hook largest; largest hooks about 67 μm long, about 22 μm wide at junction with root; 4 or 5 basal hooks, small, closely crowded, lacking recurved roots; proboscis receptacle sacciform, with double-layered muscular walls, extending posteriorly to level of testes; lemnisci slightly shorter than receptacle; lacunar system mesh-like, main canals not prominent; testes spheroidal, contiguous or overlapping, reaching anteriorly to posterior level of receptacle; cement glands six, pyriform, usually arranged in approximate pairs; eggs 79–101 μm long, 16–29 μm wide, with middle membrane forming rounded polar prolongations.

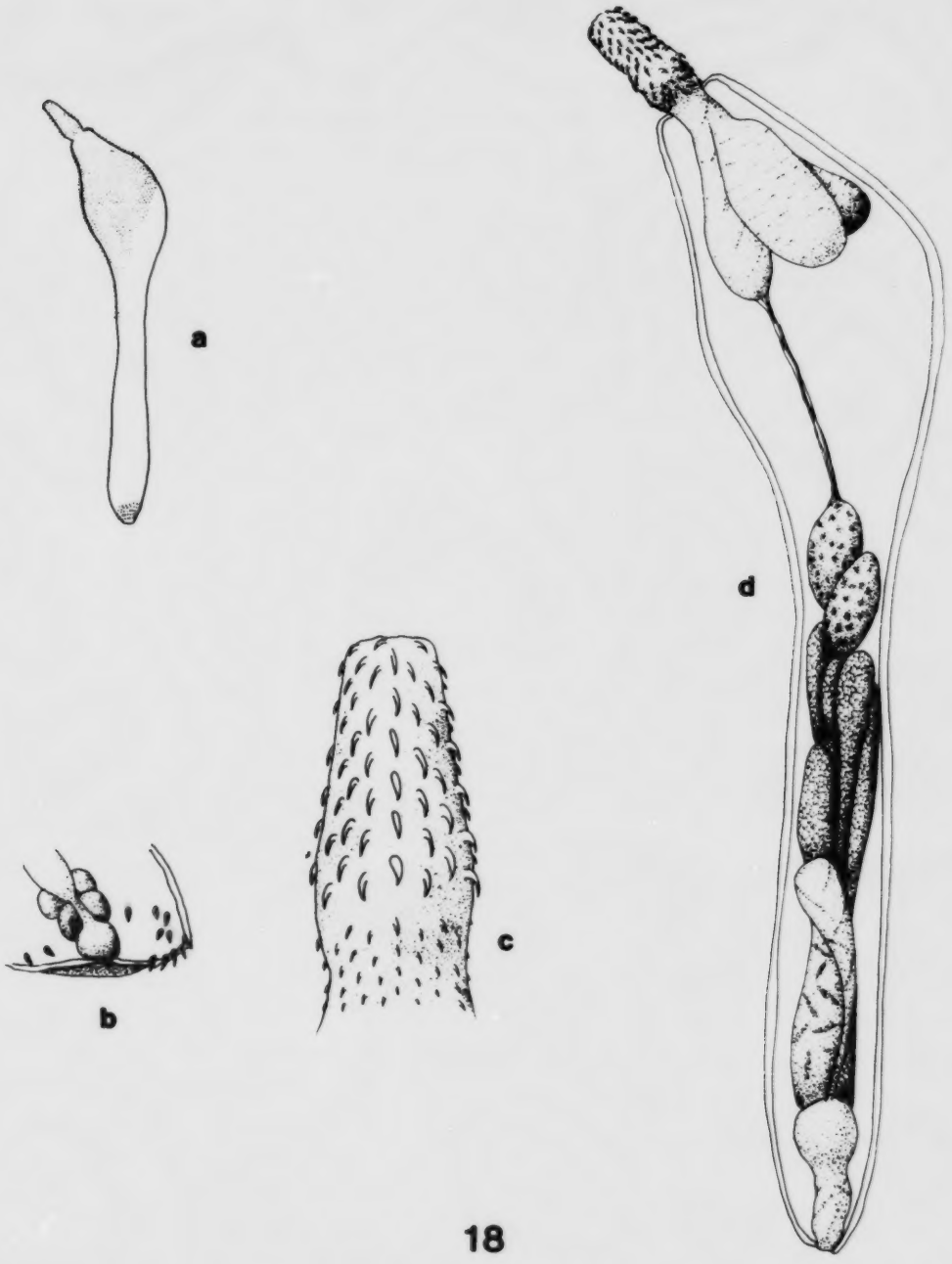

FIG. 18. *Corynosoma strumosum* [a, b, c redrawn after Van Cleave (1953a); d redrawn after Yamaguti (1963)]: (a) male showing trunk spination; (b) terminal portion of female genitalia; (c) proboscis; (d) male.

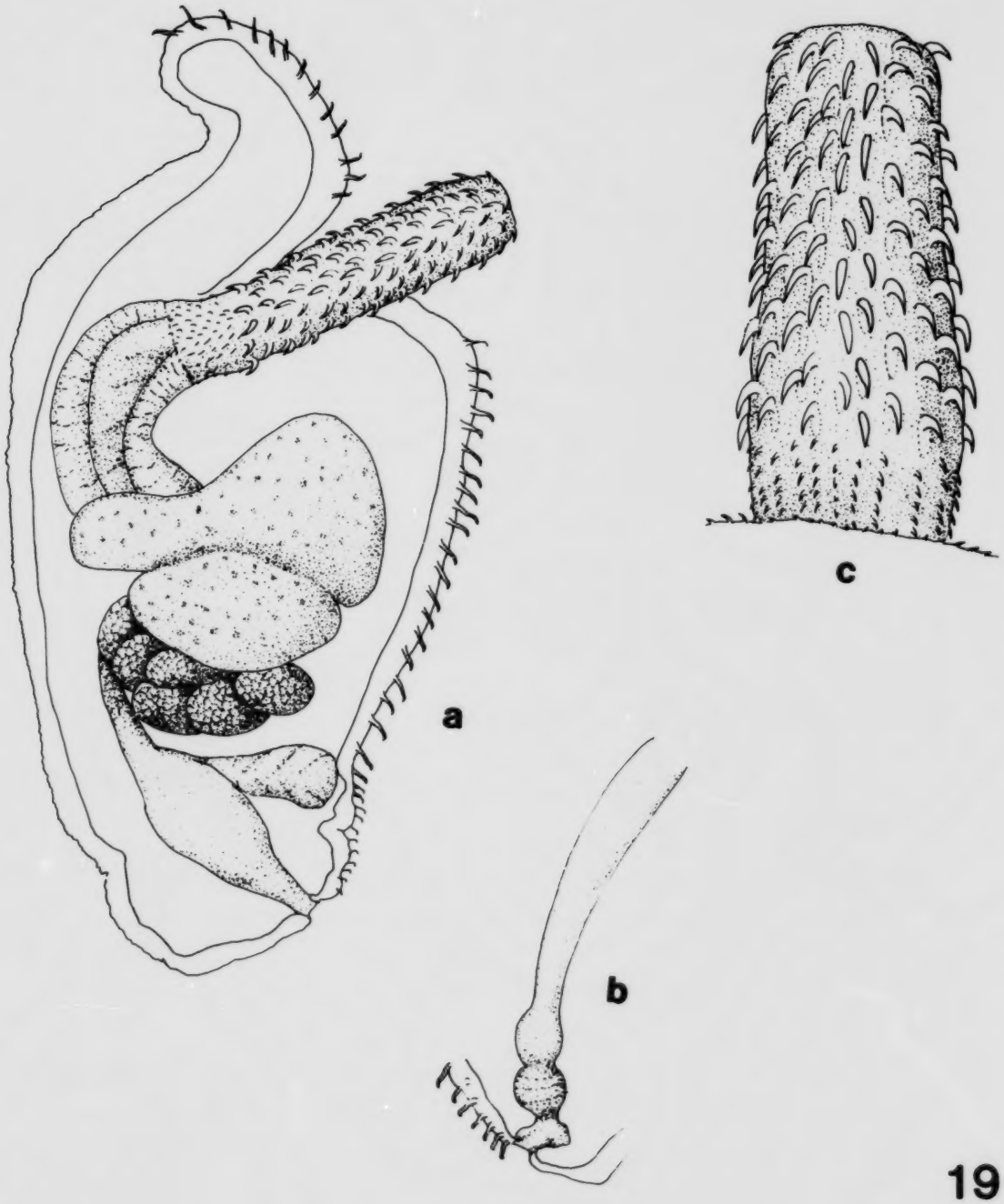

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FIG. 19. *Corynosoma semerme* [all redrawn after Van Cleave (1953a)]: (a) male; (b) terminal portion of female genitalia; (c) proboscis.

Site: [intestine]
Host: *Pseudopleuronectes americanus*.
Record: Montreuil 1955 (Atl).

Band of spines not reaching posterior end; if spines surround genital pore, they do not unite with spines of anterior part of trunk ..... *C. villosum* Van Cleave, 1953 (Fig. 20)

Description (modifed after Van Cleave 1953a, b, Petrochenko 1956b, Golvan 1959a, and Yamaguti 1963): body with fore-trunk somewhat enlarged but not sharply set off from plump hind-trunk; anterior end of fore-trunk in form of a truncated cone, merging into the short, aspinose neck; field of trunk spines restricted dorsally to anterior part of fore-trunk, extending entire length of trunk enlargement ventrally; genital spines prominent in males and young females, widely scattered over genital extremity, sigmoid or flat, broadly triangular, 44–53 μm long, 12–19 μm wide; proboscis (Fig. 20b) broadly vase-shaped, slightly larger in females than in males, enlarged basally, armed with 22–24 longitudinal rows of 12–13 hooks each; basal 4–6 hooks simple, thorn-like, without recurved roots, closely set in rows; apical hooks approximately equal in size, roots about equal in size to respective blades; apex of proboscis often with smooth, rounded, hyaline cap.

Males (Fig. 20c, d): body 3.5–6.35 long; 1.36–1.60 in greatest width, 0.42–0.69 wide posteriorly; trunk spines 44–53 μm long, 12–19 μm wide; proboscis slightly smaller than in female, largest hooks 58–61 μm long; testes ellipsoidal, obliquely arranged, reaching anteriorly to level of receptacle; cement glands six, clavate, immediately posterior to testes, each about twice as long as wide; genital spines 53 μm long.

Females (Fig. 20a): body 6.4–13.0 long, 1.78–1.85 in greatest width, 0.46–0.92 wide posteriorly; trunk spines 29–41 μm long, 5–8 μm wide; proboscis 0.69–0.76 long, 0.346–0.45 in greatest width, 0.208–0.23 wide at apex and base, largest hooks 69–79 μm long, 27 μm wide at junction with root; roots about as long as blade; edge of gonopore elevated slightly into lip-like ring; vaginal sphincter muscular, swollen, filling body cavity near gonopore; eggs 98–140 μm long, 24–32 μm wide, with middle membrane forming small, rounded polar prolongations.

Site: mesenteries
Hosts: *Atheresthes stomias* (4); *Clupea harengus pallasi* (3); *Oncorhynchus nerka* (1); *Sebastes alutus* (2).
Records: 1. Margolis 1958 (Pac); 2. Sekerak and Arai 1973 (Pac); 3. Arthur and Arai 1980a (Pac); 4. Kabata and Whitaker 1984 (Pac).

Corynosoma sp. (juvenile)

Sites: mesenteries, coelom, intestine
Hosts: *Anoplopoma fimbria* (12); *Atheresthes stomias* (12); *Cymatogaster aggregata* (3, 4); *Gadus morhua* (9); *Glyptocephalus cynoglossus* (2); *Hippoglossoides platessoides* (2); *Hippoglossus hippoglossus* (1, 2); *Leptocottus armatus* (3, 4); *Limanda ferruginea* (2); *Melanogrammus aeglefinus* (7); *Microstomus pacificus* (12); *Myoxocephalus polyacanthocephalus* (3, 4); *Oncorhynchus gorbuscha* (10); *O. kisutch* (4); *Pollachius virens* (13); *Pseudopleuronectes americanus* (1, 2); *Salvelinus alpinus* (8); *Scophthalmus aquosus* (1); *Sebastes aleutianus* (6); *S. alutus* (5, 6); *S. borealis* (6); *S. brevispinis* (6); *S. caurinus* (6); *S. ciliatus* (6); *S. elongatus* (6); *S. helvomaculatus* (6); *S. maliger* (6); *S. ruberrimus* (6); *S. zacentrus* (6); *Theragra chalcogramma* (11, 12).
Records: 1. Montreuil 1955 (Atl); 2. Ronald 1963 (Atl); 3. Arai 1967 (Pac); 4. 1969 (Pac); 5. Sekerak and Arai 1973 (Pac); 6. 1977 (Pac); 7. Scott 1981 (Atl); 8. Dick and Belosevic 1981 (NWT); 9. Appy and Burt 1982 (Atl); 10. Margolis 1982 (Atl); 11. Arthur 1984 (Pac); 12. Kabata and Whitaker 1984 (Pac); 13. Scott 1985 (Atl).

Bolbosoma Porta, 1908

Diagnosis (modified after Van Cleave 1924, Petrochenko 1956b, Golvan 1960b, Yamaguti 1963, and Machado 1964): body medium to very large; trunk with bulbous anterior part distinctly divided into three parts: anterior bulbar portion with 2–3 fields of trunk spines, aspinose medial annular bulb, aspinose bulbar region; remaining portion of trunk totally aspinose, attenuated; main lacunar canals lateral, with annular commissures alternating with circular muscle bands; neck short, cylindrical, aspinose, well-marked; proboscis short,

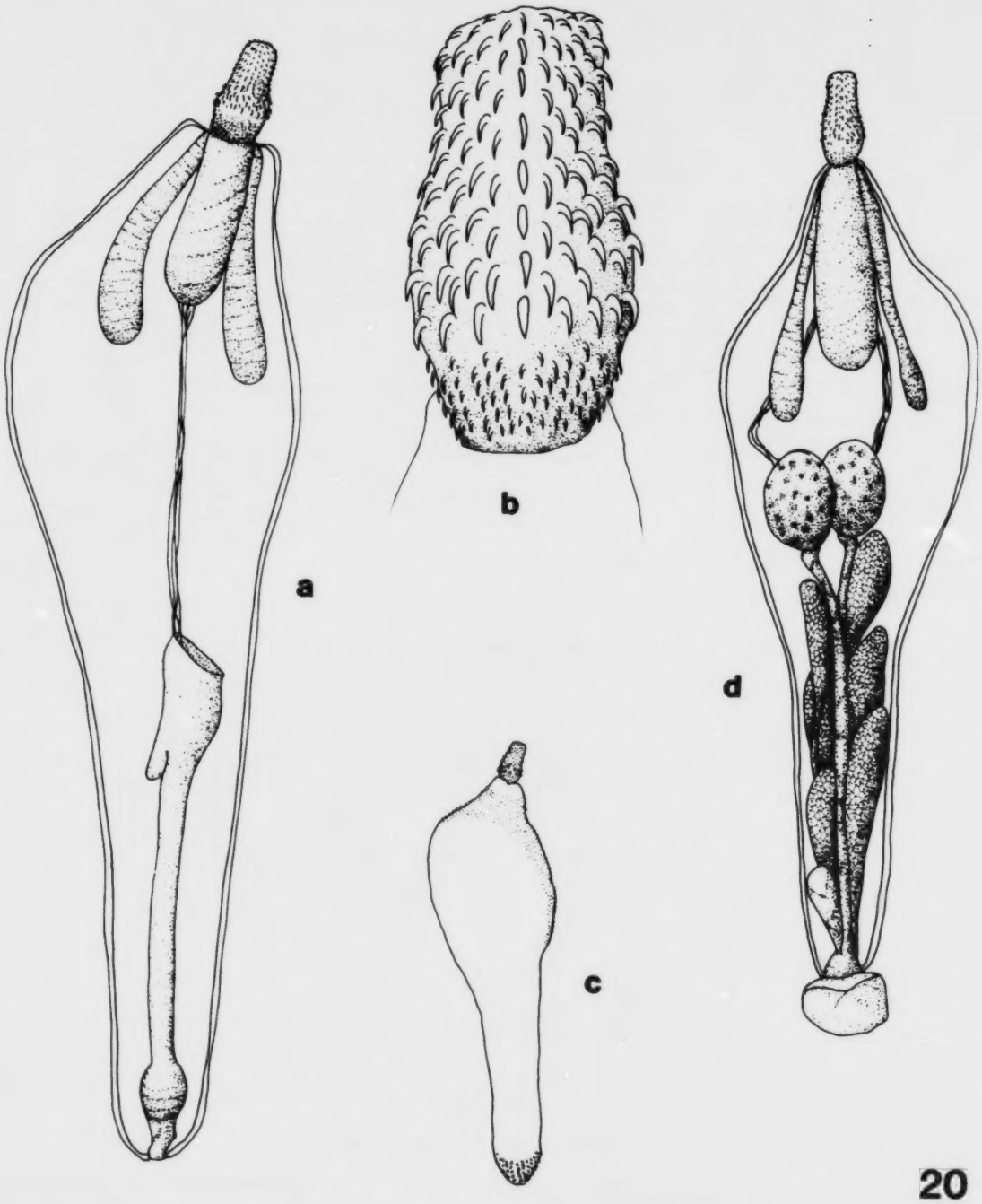

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FIG. 20. *Corynosoma villosum* [a redrawn after Baer (1951); b, c, d redrawn after Van Cleave (1953a)]: (a) female; (b) proboscis; (c) male showing trunk spination; (d) male.

spheroid or claviform, armed with 12–26 longitudinal rows of 5–9 hooks each; basal hooks with rudimentary roots; proboscis receptacle double-walled, cylindrical, with ganglion in posterior half; lemnisci of variable length and form, slender or occasionally lobate; testes ellipsoidal or subspherical, tandem, usually in middle third of trunk or at level of trunk constriction; cement glands usually 2–6, very long, cylindrical, usually subequal in size; genital spines absent; eggs large, with polar prolongations of middle membrane.

Juveniles of one species in fishes of Canada.

Bolbosoma caenoforme (Heitz, 1919) Meyer, 1935 (Fig. 21)

Synonyms: *Bolbosoma* sp. *sensu* Margolis 1956, 1957

Description (modified after Zschokke and Heitz 1914, Heitz 1919, Petrochenko 1956b, and Yamaguti 1963): body 6.7 long, 0.76 wide, distinctly divided into broadened, pyriform forebody and slender, cylindrical hindbody (Fig. 21a); hindbody 3.5–4.0 long, 0.36–0.43 wide anteriorly, 0.21–0.25 wide posteriorly; forebody with spines, giving trunk a scale-like surface; neck short, conical; proboscis (Fig. 21b) short, subcylindrical, slightly enlarged medially, 0.54–0.684 long, 0.234–0.34 wide, armed with 18–20 longitudinal rows of six hooks each; first 5 hooks of each row large and strong, 83 μm long, 12 μm wide at base; basal hook of each row less developed than other five, without roots, 56 μm long; proboscis receptacle double-walled, 0.68 long, with ganglion at mid-level; lemnisci sacciform, located on each side of receptacle, slightly longer than receptacle; lacunar system with two longitudinal canals, with ring-like commissures.

Site: intestine

Hosts: *Oncorhynchus gorbuscha* (1, 2, 3, 4); *O. nerka* (1, 2, 3); *Theragra chalcogramma* (5).

Records: 1. Margolis 1956 (Pac, BC); 2. 1957 (Pac, BC); 3. 1963 (Pac, BC); 4. Anonymous 1984 (BC); 5. Arthur 1984 (Pac).

Remarks: *Bolbosoma* sp. of Margolis 1956, 1957 was identified as *B. caenoforme* by Margolis (1963).

CLASS EOCANTHOCEPHALA Van Cleave, 1936

General characters (modified after Van Cleave 1936, Golvan 1959b, Schmidt 1973, and Amin 1982): body with thick walls; trunk spinose or aspinose; hypodermis with few ovoid or amoeboidal, giant nuclei; main lacunar canals dorsal and ventral, interconnected by pseudometamerically arranged transverse commissures; proboscis retractable, with radially arranged hooks; proboscis hooks without pronounced asymmetry on various surfaces, formula usually constant for most species; proboscis receptacle with single, thick muscular wall, ganglion usually located posteriorly in proboscis receptacle; lemnisci with few, large nuclei; two ligament sacs of females persistent, usually distinct, dorsal and ventral; protonephridia lacking; cement gland single, syncytial, containing giant nuclei, with cement reservoir; eggs variable in shape, membranes thin.

Neoechinorhynchida Southwell and MacFie, 1925

General characters (modified after Southwell and MacFie 1925, Yamaguti 1963, and Amin 1982): body small to large, trunk spinose or aspinose; hypodermis with few, large, amoeboid or fragmented nuclei; proboscis spheroid to elongate, invaginable, usually provided with comparatively small number of hooks; proboscis receptacle single-walled; cement gland syncytial, rarely divided into two lobes; eggs elliptical, usually without polar prolongations of middle membrane.

One family in freshwater fishes of Canada.

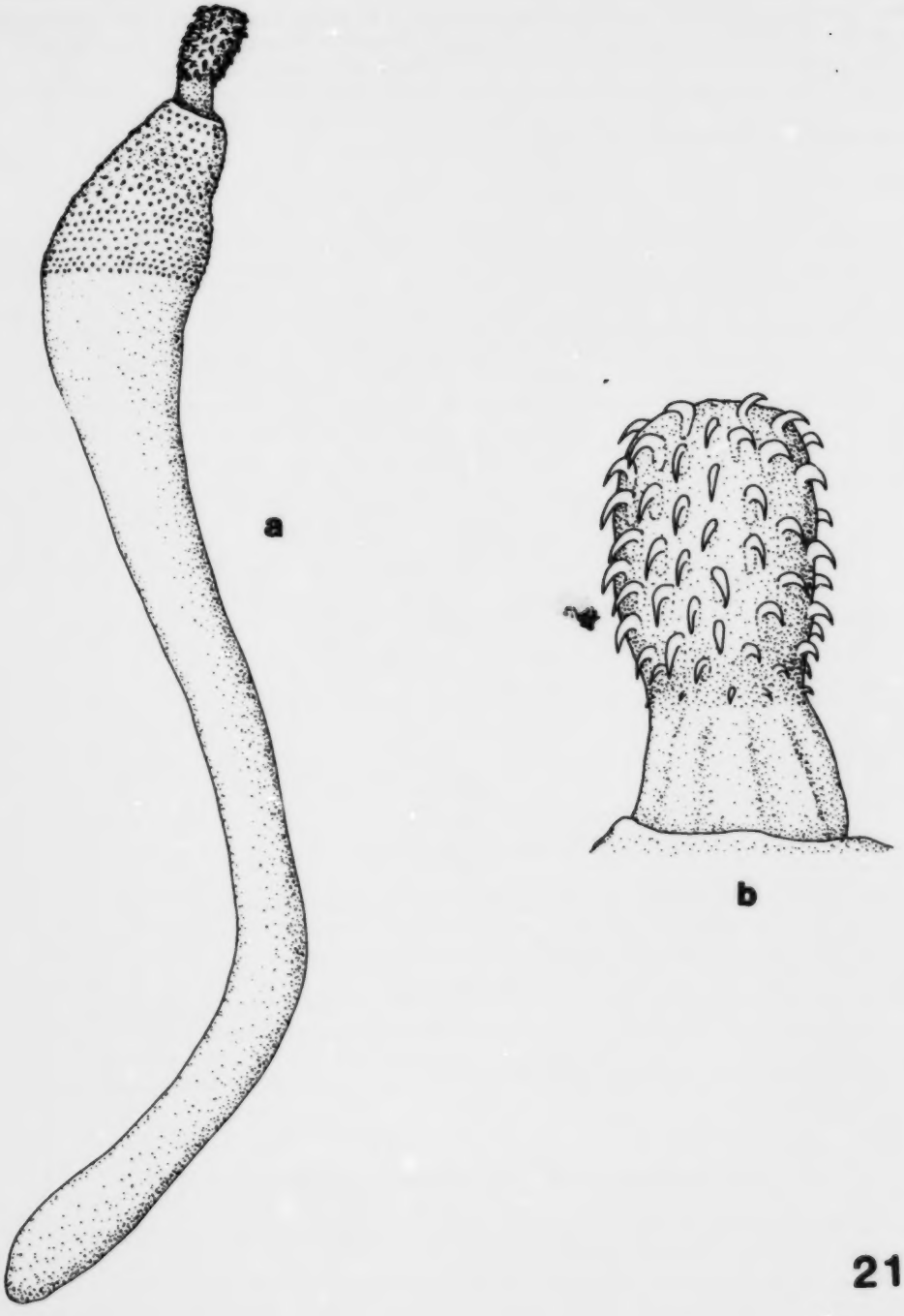

FIG. 21. *Bolbosoma caenoforme* [both original]: (a) female showing trunk spination; (b) proboscis.

Neoechinorhynchidae Ward, 1917

General characters (modified after Van Cleave 1919, Yamaguti 1963, and Amin 1982): body small to medium sized; trunk aspinose; hypodermal nuclei extremely large, normally few in number, in definite arrangement: five in mid-dorsal line of body, one in mid-ventral line anteriorly; nuclei of lemnisci large, normally two in one lemniscus, one in the other; proboscis variable in shape, with hooks arranged in longitudinal, spiral, or transverse rows; proboscis receptacle single-walled, inserted at base of proboscis; lemnisci short to long; eggs elliptical, membranes fully concentric, without polar modification or constrictions; testes ovoid to elliptical, rarely more elongate, usually contiguous; syncytial cement gland with relatively few giant nuclei, with cement reservoir.

Key to genera of Neoechinorhynchidae

1 Proboscis short, globular (or slightly claviform or subcylindrical), hooks in three circles of 6 hooks each; lemnisci of medium size, reaching to anterior testis ..... *Neoechinorhynchus*

Proboscis small, globular, hooks in three circles of 8–10 hooks each; lemnisci rather short, far from anterior testis 2

2 Proboscis hooks with roots in all three circles; female gonopore nearly terminal..... ..... *Octospiniferoides*

Proboscis hooks with roots in only two circles; female gonopore definitely subterminal ..... *Octospinifer*

Neoechinorhynchus Stiles and Hassall, 1905
Synonym: *Eosentis* Van Cleave, 1914

Diagnosis (modified after Van Cleave 1919, Petrochenko 1956a, and Yamaguti 1963): body delicate, usually small, thin-walled, cylindrical, bowed or straight; giant hypodermal nuclei usually few (4–5 dorsally and 1–2 ventrally), generally constant in number and in position; proboscis short, globose, small, armed with three circles of six hooks each; apical hooks conspicuously longer and stouter than others, with reflexed root processes; roots broad, discoid, pyriform in surface view; blade or hook proper attached at apical end of root, appreciably longer than root; proboscis receptacle subcylindrical, rather short, single-walled, with ganglion at or near base; lemnisci digitiform to filiform, long, with few giant nuclei; testes contiguous or not, equatorial, sometimes in posterior half of trunk; cement glands syncytial, with several nuclei; cement reservoir rounded, overlapped by cement gland; bursa weakly developed; eggs oval to elliptical, with thin concentric membranes.

Key to species of *Neoechinorhynchus*

1 Hooks in middle circle about as large or not markedly shorter than those of apical circle 2

Hooks of middle circle shorter than those of apical circle 5

2 Hooks of apical circle shorter than 40 μm ..... *N. notemigoni* Dechtiar, 1967 (Fig. 22)

Description (modified after Dechtiar 1967): body relatively small, slender, cylindrical, tapering slightly towards both extremities; proboscis (Fig. 22b) small, short, cylindrical; dorsal body wall without conspicuous thickenings; sexual dimorphism not prominent in mature individuals.

Males (Fig. 22c): body 2.83–3.70 long, with maxiumum diameter 0.396–0.576 at level one-third length of trunk from anterior end; external praesoma 0.104–0.129 long; proboscis 0.079–0.088 long, 0.089–0.113 wide; proboscis receptacle 0.207–0.245 long, 0.089–0.113 wide; apical proboscis hooks 24–28 μm long; median hooks 18–31 μm long; basal hooks 15–23 μm long; thickest part of dorsal body wall 16–39 μm; uninucleate lemniscus 0.50–0.849 long; binucleate lemniscus 0.86–1.811 long; anterior testis 0.566–1.094 long, 0.141–0.377 wide; posterior testis 0.453–0.783 long, 0.155–0.377 wide; cement gland 0.30–0.744 long; cement reservoir 0.15–0.264 long, ovoid, with two cement ducts passing to copulatory apparatus; bursa longer than wide.

Females (Fig. 22a): body 3.30–6.20 long, with maximum diameter 0.443–0.679; external praesoma 0.122–0.163 long; proboscis 0.089–0.099 long, 0.089–0.104 wide; apical proboscis hooks 26–39 μm long; median hooks 20–29 μm long; basal hooks 17–23 μm long; thickest part of dorsal body wall 22–30 μm; proboscis receptacle 0.207–0.283 long; uninucleate lemniscus 0.630–1.420 long; binucleate lemniscus 1.056–1.849 long; posterior end rounded; gonopore terminal; eggs 10–22 μm, 10–17 μm wide.

Site: intestine

Host: *Notemigonus crysoleucas*.

Record: Dechtiar 1967 (Ont).

Hooks of apical circle longer than 40 μm 3

3 Hooks of apical circle longer than 90 μm; proboscis longer than wide, length greater than 0.2 ..... *N. crassus* Van Cleave, 1919 (Fig. 23)

Description (modified after Van Cleave 1919, Lynch 1936, Petrochenko 1956a, and Yamaguti 1963): body short, thick, subcylindrical, tapering slightly toward either extremity, rounded or truncated posteriorly, greatest diameter at level of ventral hypodermal nucleus; proboscis hooks arranged in three circles with six hooks each (Fig. 23b); only hooks of apical circle with prominent roots; proboscis 0.20–0.325 long, 0.19–0.27 wide; body wall very thick, usually 0.052–0.134 thick except anteriorly in gravid females.

Males (Fig. 23a): body 3.45–7.0 long, 0.40–0.79 wide at level of ventral giant nucleus, tapering to a rounded posterior end; apical proboscis hooks 0.071–0.10 long; median hooks 60–83 μm long; basal hooks 40–71 μm long; proboscis receptacle 0.45–0.60 long, 0.053–0.10 wide; binucleate lemniscus 60–77% of total body length; uninucleate lemniscus 33–90% of total body length; testes broadly contiguous, overlapping; anterior testis 0.485–0.87 long, 0.16–0.38 wide; posterior testis 0.44–0.87 long, 0.165–0.338 wide; cement gland almost always contiguous with posterior testis, 0.60–1.25 long, 0.24–0.40 wide, with 8 giant nuclei; cement reservoir 0.19–0.39 long, 0.11–0.27 wide; retracted bursa 5.9–10.5% of total body length; seminal vesicle 0.16–0.28 long, 0.045–0.13 wide.

Females: body 5.2–9.0 long, 0.65–0.93 in greatest diameter; apical proboscis hooks 88–105 μm long; median hooks 73–90 μm long; basal hooks 40–71 μm long; proboscis receptacle 0.40–0.69 long, 0.145–0.20 wide; binucleate lemniscus 52–90% of total body length; uninucleate lemniscus 42–89% of total body length; ovaries 0.093–0.24 long, 0.055–0.11 wide, in dorsal ligament; eggs 32–53 μm long, 15–30 μm wide; embryos 25–45 μm long, 11–21 μm wide; gonopore terminal.

Site: intestine

Hosts: *Carpiodes cyprinus* (7); *Catostomus catostomus* (6, 9); *C. commersoni* (1, 2, 3, 4, 6, 8); *C. macrocheilus* (5); *Moxostoma macrolepidotum* (3 (as *Moxostoma aureolum*)).

Records: 1. Bangham and Hunter 1939 (Ont); 2. Van Cleave 1949 (Sask); 3. Stewart-Hay 1951b (Man); 4. 1953B (Man); 5. Bangham and Adams 1954 (BC); 6. Bangham 1955 (Ont); 7. Dechtiar 1972a (Ont); 8. 1972b (Ont); 9. Chinniah and Threlfall 1978 (Lab).

Remarks: The record of *N. crassus* from *Stizostedion vitreum vitreum* from Manitoba cited in Margolis and Arthur (1979) and attributed to Stewart-Hay (1951b) by Lubinsky (1976) is incorrect. Stewart-Hay's (1951b) record is *Neoechinorhynchus* (probably *N. crassus*) recovered from the hosts noted above.

Hooks of apical circle between 40 μm and 90 μm; proboscis wider than long, shorter than 0.2 4

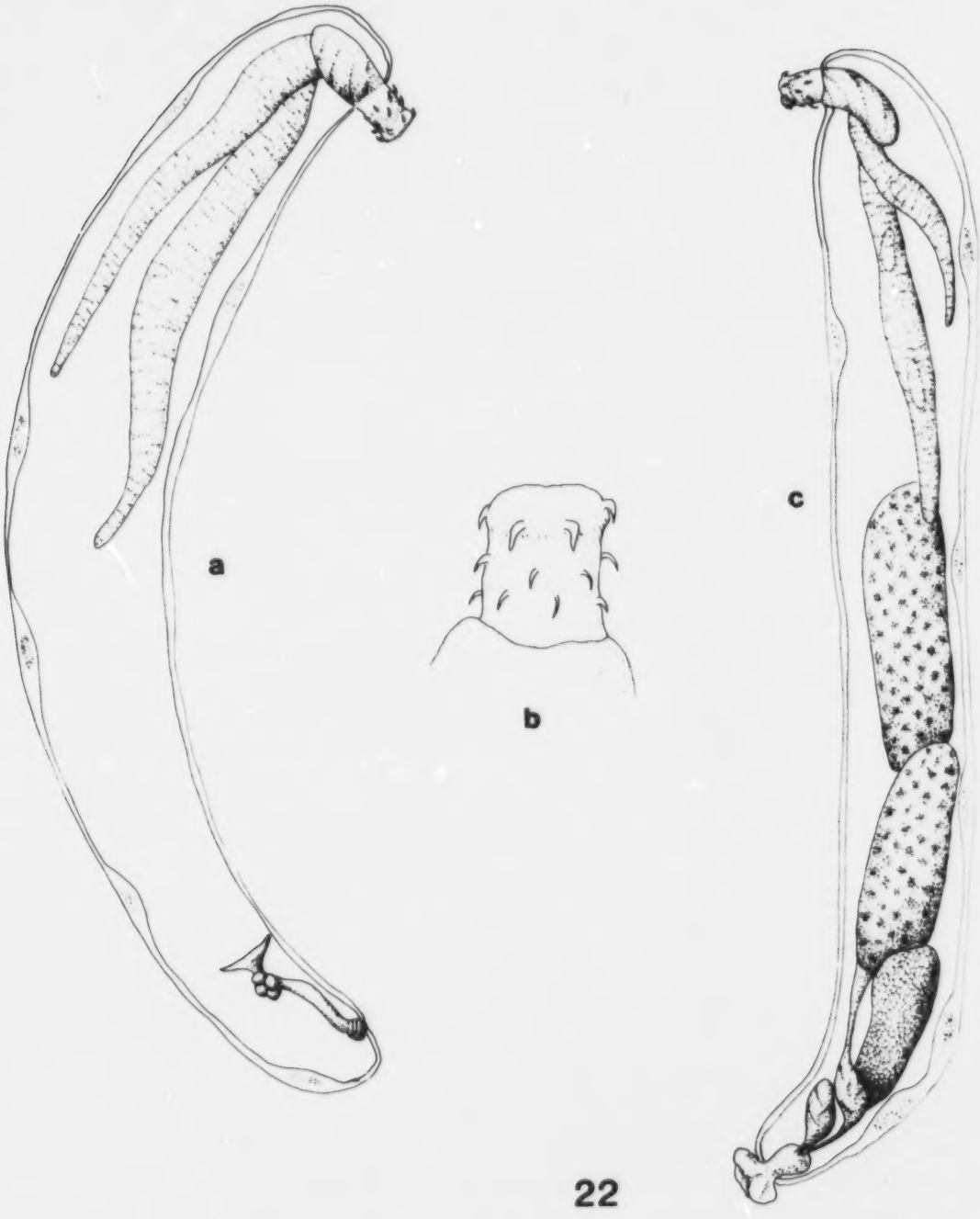

FIG. 22. *Neoechinorhynchus notemigoni* [all redrawn after Dechtiar (1967)]: (a) female; (b) proboscis; (c) male.

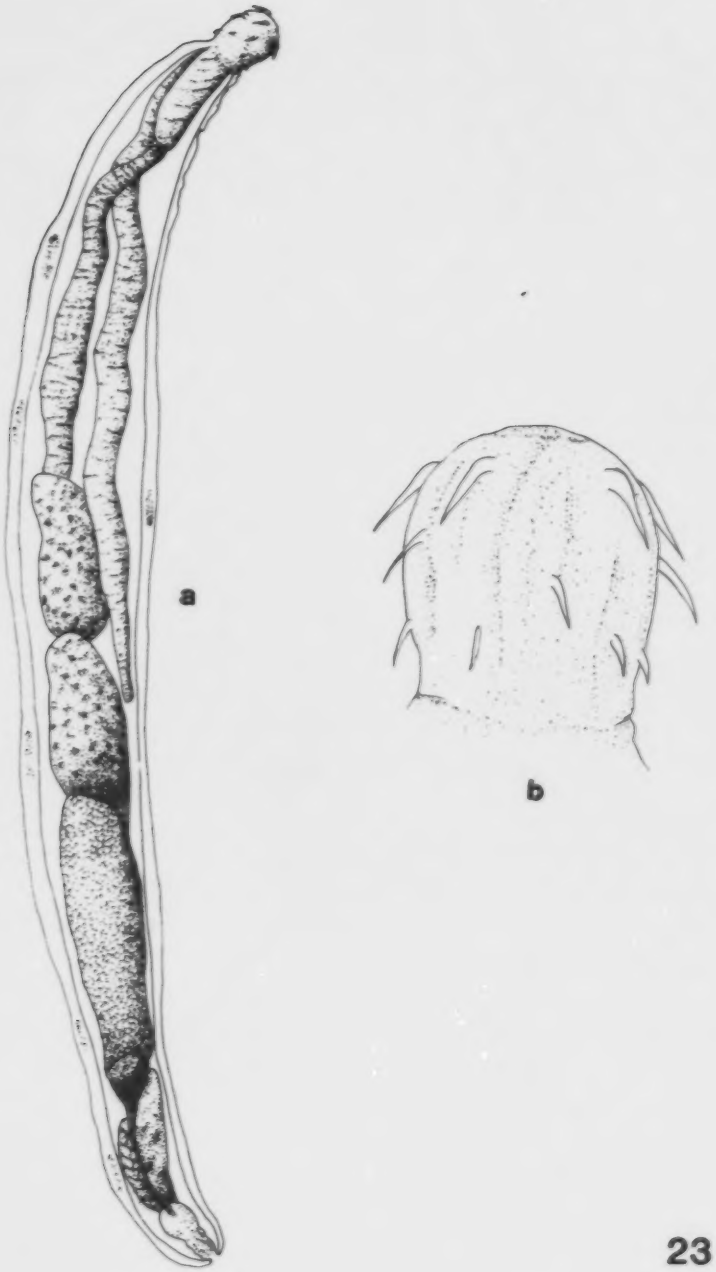

FIG. 23. *Neoechinorhynchus crassus* [both redrawn after Van Cleave (1919)]: (a) male; (b) proboscis.

4 Lemnisci nearly equal in length ..... *N. tumidus* Van Cleave and Bangham, 1949 (Fig. 24)

Description (modified after Van Cleave and Bangham 1949, Petrochenko 1956a, and Yamaguti 1963): body fusiform, delicate, greatest width in anterior third of trunk, enlargement distinct in females; five giant nuclei dorsally; one nucleus ventrally; proboscis (Fig. 24b) small, spherical, with three circles of six hooks each; first two hooks of each row large; basal hooks small, without roots. Males (Fig. 24c): body cylindrical, lacking enlargement seen in females, 3.0–6.3 long, 0.7–1.5 wide; proboscis small, subspherical, 0.119–0.172 long; apical proboscis hooks 55–84 μm long, 9 μm wide, with root 32 μm long, 9 μm wide; median hooks 52–79 μm long, 9 μm wide, with roots as in apical hooks; basal hooks 40–53 μm long, 3 μm wide, without roots; proboscis receptacle sacciform, single-walled 0.47 long, 0.15 wide; lemnisci subequal, reaching level of posterior testis; binucleate lemniscus 2.18–2.59 long; uninucleate lemniscus 1.88–2.2 long; testes elongate, contiguous, in posterior half of trunk; anterior testis 1.10 long, 0.47 wide; posterior testis 0.86 long, 0.55 wide; cement gland syncytial, with giant nuclei, contiguous with testes, 1.34 long.

Females (Fig. 24a): body 4.0–12.0 long, 0.87–2.5 wide at enlarged anterior third of trunk; width at juncture of neck and trunk 0.30–0.40; width of subcylindrical posterior part 0.85; proboscis slightly larger than in males, 0.132–0.172 long, 0.172–0.210 wide; armature of proboscis as in males, with hooks somewhat larger; apical hooks 65–85 μm long, with roots 35–42 μm long; median hooks 65–79 μm long, with roots 36–42 μm long; basal hooks 45–53 μm long, without roots, needle-shaped; lemnisci longer than those of males, 2.8–3.9 and 3.2–4.7 long; ovaries fragmented; eggs oval, 32–40 μm long, 16–19 μm wide; gonopore subterminal, at base of slight post-genital protuberance.

Site: intestine

Hosts: *Coregonus artedii* (1 (as *Leucichthys artedii*), 4); *C. clupeaformis* (1, 3, 4, 5, 6, 8); *C. hoyi* (7); *Cottus cognatus* (6); *Esox lucius* (6); *Oncorhynchus nerka* (5); *Osmerus mordax* (7); *Prosopium cylindraceum* (2, 6); *P. williamsoni* (6); *Salvelinus fontinalis* × *S. namaycush* (7); *Thymallus arcticus* (6).

Records: 1. Van Cleave and Bangham 1949 (Sask); 2. Bangham 1955 (Ont); 3. Dechtiar 1972a (Ont); 4. 1972b (Ont); 5. Collins and Dechtiar 1974 (Ont); 6. Arthur et al. 1976 (YT); 7. Dechtiar and Berst 1978 (Ont); 8. McAllister and Mudry 1983 (Alta).

Lemnisci differ greatly in length ..... *N. cristatus* Lynch, 1936 (Fig. 25)

Synonym: *Neoechinorhynchus venustus* Lynch, 1936

Description (modified after Lynch 1936, Petrochenko 1956a, and Yamaguti 1963): with the characters of the genus.

Males (Fig. 25c): body cylindrical, 2.5–6.4 long, 0.30–0.40 in greatest diameter at level between first and third hypodermal nuclei, without marked tapering as in females; proboscis (Fig. 25b) 0.093–0.143 long, 0.070–0.145 wide; apical proboscis hooks 40–57 μm long; median hooks more slender than apical ones, 26–55 μm long; basal hooks 23–38 μm long; proboscis receptacle 0.205–0.335 long, 0.06–0.12 wide; maximum thickness of body wall 0.045–0.12; binucleate lemniscus 23–64% of total body length; uninucleate lemniscus 16–38% of total body length; testes usually contiguous, overlapping; anterior testis 0.39–1.35 long, 0.155–0.33 wide; posterior testis 0.365–1.08 long, 0.175–0.39 wide; cement gland usually contiguous with posterior testis, 1.425–1.600 long, 0.140–0.300 wide; cement reservoir 0.17–0.34 long, 0.082–0.225 wide; seminal vesicle 0.135–0.355 long, 0.03–0.115 wide; muscular sac 0.24–0.69 long, 0.040–0.12 wide; retracted bursa 8–10% of total body length.

Females (Fig. 25a): body 3.85–12.75 long, 0.32–1.0 wide; greatest diameter usually at level between first and third dorsal nuclei; body tapering from this point to comparatively narrow anterior end and to a long, slender, obliquely truncated posterior end; proboscis 0.087–0.137 long, 0.073–0.147 wide; apical proboscis hooks 45–59 μm long; median hooks 39–57 μm long; basal hooks 24–41 μm long; proboscis receptacle 0.25–0.32 long, 0.085–0.125 wide; binucleate lemniscus 12–35% of total body length; uninucleate lemniscus 9.5–22.0% of total body length; body wall 0.068–0.52 in thickest portion; gonopore ventral, 1.2–2.5% of total body length from posterior end; living eggs 51–72 μm long, 20–38 μm wide; living embryos 39–49 μm long, 15–25 μm wide; eggs in whole mounts 38–62 μm long, 12–26 μm wide; embryos in whole mounts 32–40 μm long, 10–15 μm wide.

Site: intestine

Hosts: *Catostomus catostomus* (1, 2, 3, 4, 9, 10, 11, 12, 13, 14); *C. commersoni* (1, 2, 3, 6, 7, 9, 11, 13); *C. macrocheilus* (1, 11, 12, 13, 14); *Mylocheilus caurinus* (1); *Ptychocheilus oregonensis* (12, 14); *Pungitius pungitius* (5, 8).

Records: 1. Bangham and Adams 1954 (BC): 2. Arai and Kussat 1967 (Alta); 3. Kussat 1969 (Alta); 4. Threlfall and Hanek 1970c (Lab); 5. Hanek and Threlfall 1970b (Lab);

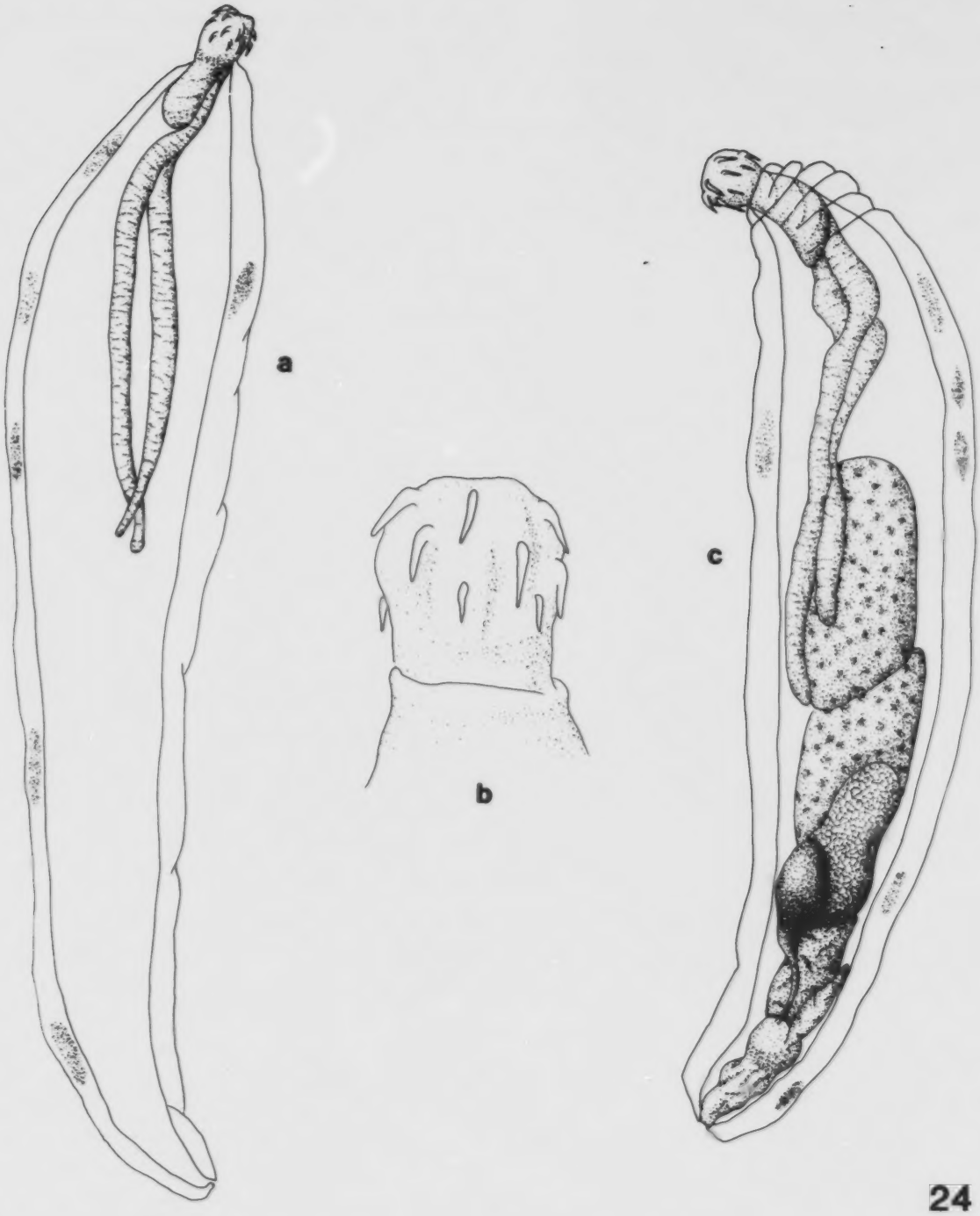

FIG. 24. *Neoechinorhynchus tumidus* [a, b redrawn after Van Cleave and Bangham (1949); c redrawn after Yamaguti (1963)]: (a) female; (b) proboscis; (c) male.

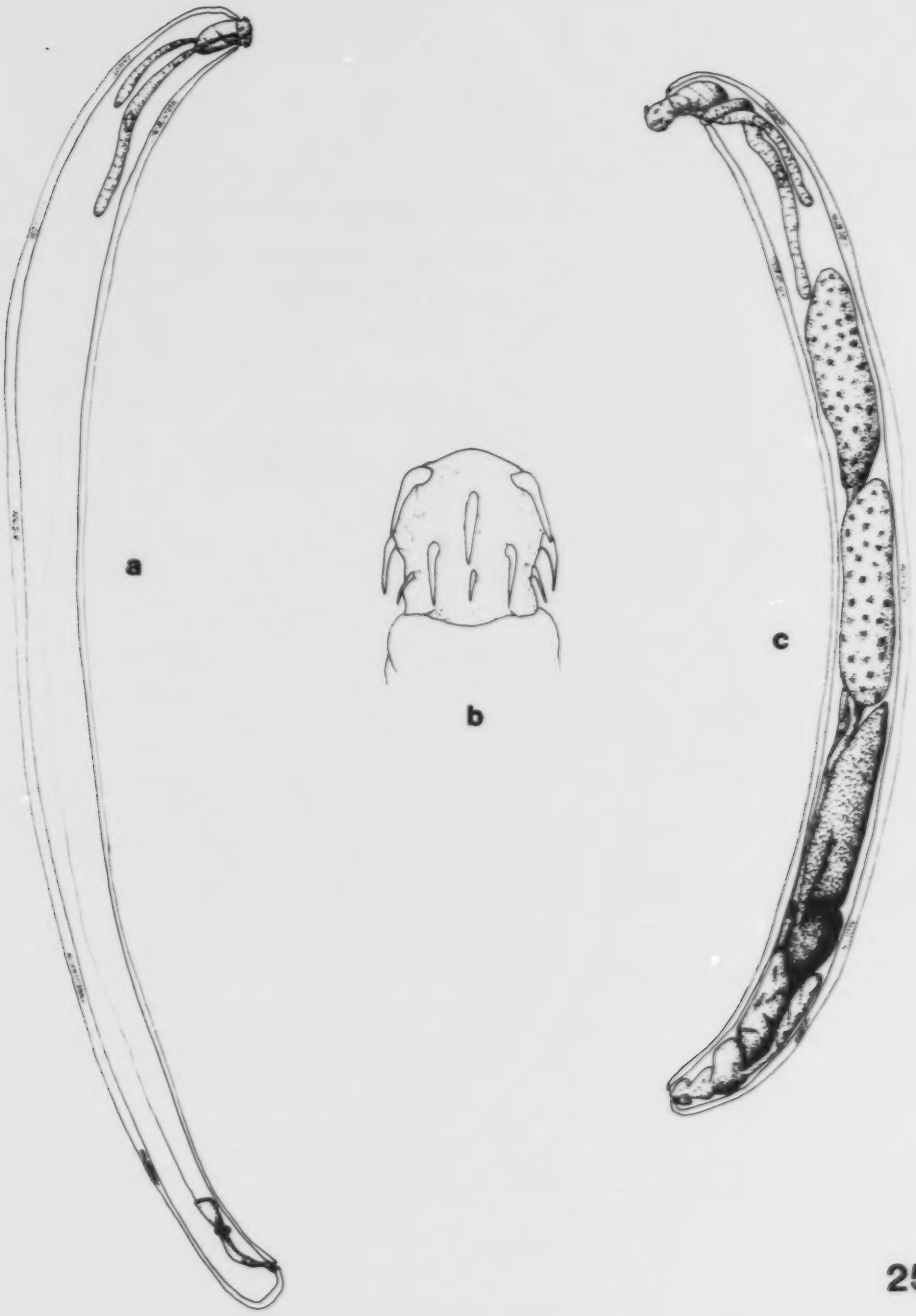

FIG. 25. *Neoechinorhynchus cristatus* [all redrawn after Lynch (1936)]: (a) female; (b) proboscis; (c) male.

6. Dechtiar 1972a (Ont); 7. 1972b (Ont); 8. Hanek and Molnar 1974 (Que); 9. Mudry and Anderson 1976 (Alta); 10. Gordon et al. 1978 (Que); 11. Anonymous 1978 (BC); 12. 1981 (BC); 13. Arai and Mudry 1983 (BC); 14. Anonymous 1984 (BC).

5 Lemnisci differ significantly in length ..... *N. carpiodi* Dechtiar, 1968 (Fig. 26)

Description (modified after Dechtiar 1968): trunk cylindrical, tapering at both ends, flexed ventrad; proboscis subspherical.

Males (Fig. 26a): body 21.2–33.5 long, 0.60–0.87 wide; external präesoma 0.137–0.191 long; proboscis (Fig. 26b) 0.087–0.115 long, 0.122–0.14 wide; proboscis receptacle 0.278–0.38 long; apical proboscis hooks 65–75 μm long; median hooks 44–51 μm long; basal hooks 26–35 μm long; uninucleate lemniscus 1.13–2.38 long; binucleate lemniscus 1.51–2.40 long; testes long, cylindrical, far from posterior end of binucleate lemniscus, with considerable distance between testes; anterior testis 1.88–3.21 long, 0.282–0.400 wide; posterior testis 1.98–2.45 μm long, 0.282–0.400 μm wide; syncytial cement gland not contiguous with testes, slightly narrower and smaller than testes, 1.70–1.84 long, 0.208–0.245 wide; cement reservoir 0.29–0.38 long, 0.208–0.245 wide.

Females: body 25.5–48.1 long, with maximum diameter 0.66–0.906; external praesoma 0.157–0.189 long; proboscis 0.114–0.132 long, 0.115–0.145 wide; proboscis receptacle 0.325–0.380 wide; apical proboscis hooks 67–71 μm long; median hooks 44–53 μm long; basal hooks 35–36 μm long; uninucleate lemniscus 1.25–2.13 long; binucleate lemniscus 2.01–3.698 long; eggs 30–34 μm long, 16 μm wide.

Site: intestine

Host: *Carpiodes cyprinus*.

Records: 1. Dechtiar 1968 (Ont); 2. 1972a (Ont).

Lemnisci nearly equal in length 6

6 Small forms, variably shaped; hooks of apical circle of male proboscis less than 45 μm in length ..... *N. pungitius* Dechtiar, 1971 (Fig. 27)

Description (modified after Dechtiar 1971): body fusiform, curving ventrad; trunk small, robust; females slightly larger than males; proboscis (Fig. 27a) globular, armed with three circles of six hooks each; apical hooks notably larger, with prominent roots; proboscis and anterior portion of body frequently retracted; four, rarely five, giant hypodermal nuclei dorsally, one ventrally; two lemnisci, about equal in length, wide, one binucleate, other uninucleate.

Males (Fig. 27c): body 0.811–2.300 long, with maximum width 0.406–0.860 at mid-level of trunk; external praesoma 0.078–0.108 long; proboscis 57–90 μm long, 79–95 μm wide; apical organ 51–63 μm long; proboscis receptacle 0.128–0.257 long; apical proboscis hooks 36–45 μm long; median hooks 25–29 μm long; basal hooks 18–23 μm long; lemnisci short, wide, subequal in size; uninucleate lemniscus 0.279–0.822 long; binucleate lemniscus 0.340–0.693 long; testes oval, in anterior half of trunk; anterior testis 0.416–0.792 long, 0.243–0.382 wide; posterior testis 0.222–0.485 long; 0.222–0.416 wide; syncytial cement gland contiguous and overlapping posterior testis, slightly larger than testes, 0.320–0.763 long, 0.187–0.556 wide; cement reservoir 0.068–0.22 long, 0.058–0.279 wide.

Females (Fig. 27b): body 0.820–2.830 long, with maximum width 0.443–1.380 at mid-level of trunk; external praesoma 0.079–0.113 long; proboscis 63–90 μm long, 84–118 μm wide; apical organ 51–65 μm long; proboscis receptacle 0.139–0.208 long; apical proboscis hooks 44–56 μm long; median hooks 23–33 μm long; basal hooks 18–27 μm long; uninucleate lemniscus 0.313–0.556 long; binucleate lemniscus 0.416–0.792 long; eggs 35–44 μm long, 26–39 μm wide; gonopore terminal; vagina shorter than uterus, with two sphincters at each end; uterine bell weakly muscular.

Site: intestine

Hosts: *Culaea inconstans* (1); *Oncorhynchus nerka* (2); *Osmerus mordax* (2); *Perca flavescens* (1); *Pungitius pungitius* (1).

Records: 1. Dechtiar 1971 (Ont); 2. Collins and Dechtiar 1974 (Ont).

Longer, cylindrical forms; hooks of apical circle of male proboscis more than 45 μm in length 7

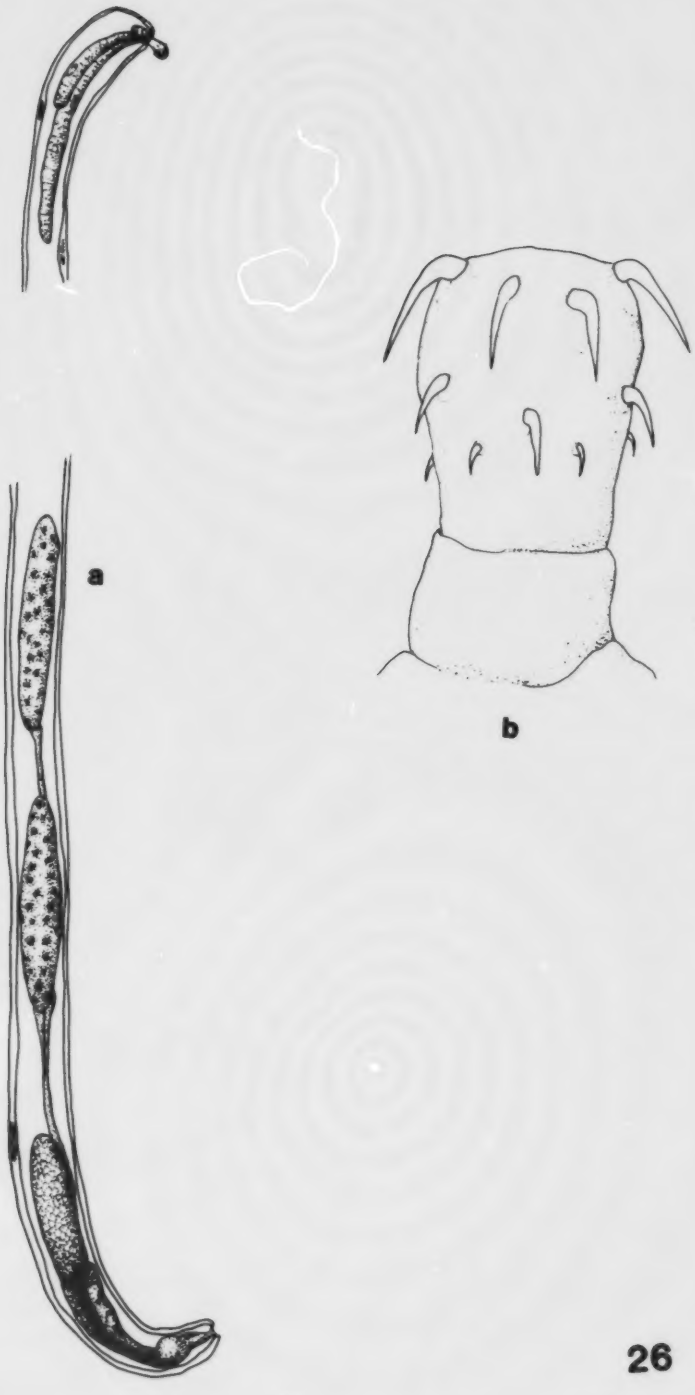

FIG. 26. *Neoechinorhynchus carpiodi* [both redrawn after Dechtiar (1968)]: (a) male; (b) proboscis.

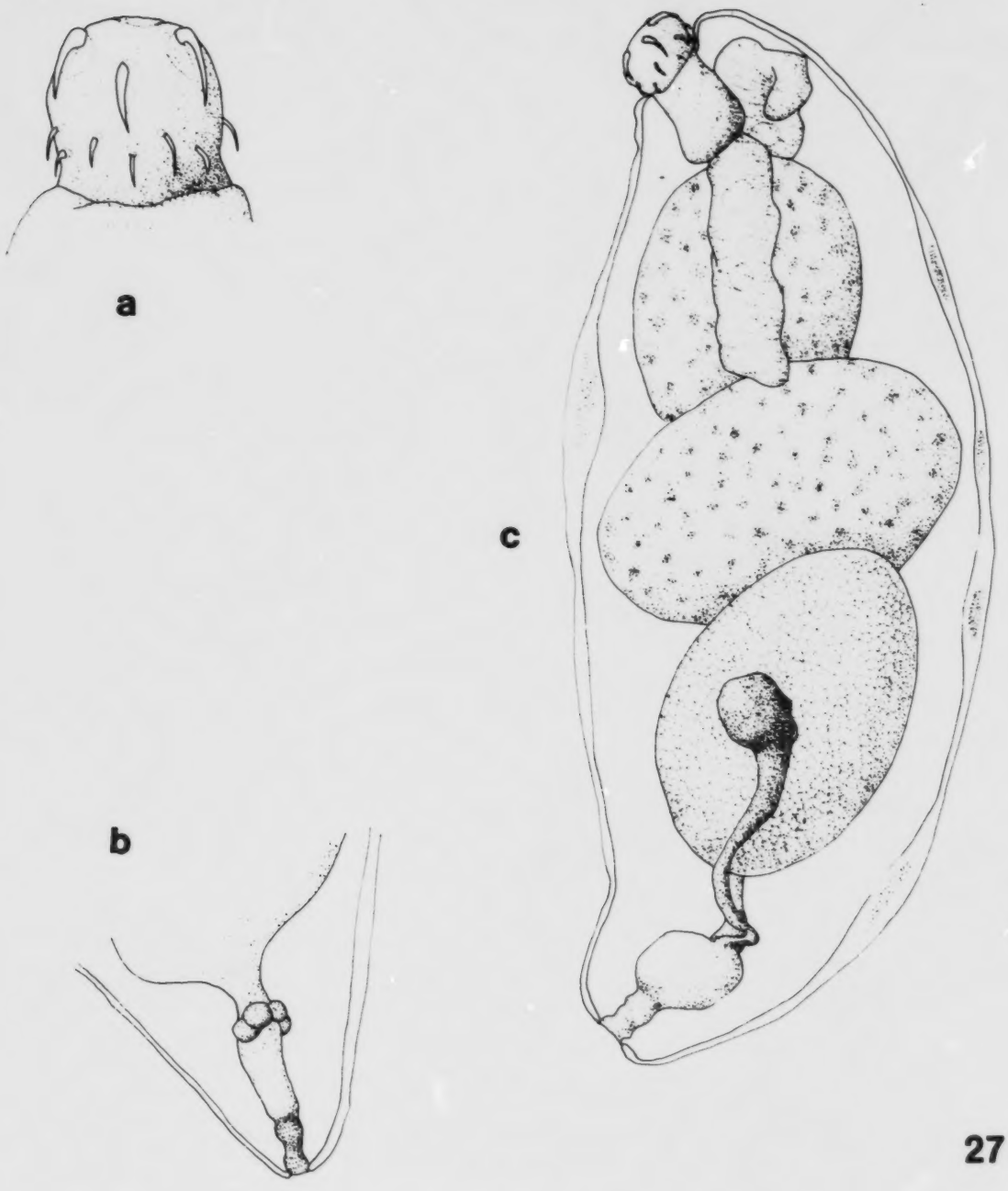

FIG. 27. *Neoechinorhynchus pungitius* [all redrawn after Dechtiar (1971)]: (a) proboscis; (b) terminal portion of female genitalia; (c) male.

7 Hooks of apical circle 90–110 μm long; proboscis longer than wide, about 0.15 long .... *N. tenellus* (Van Cleave, 1913) Van Cleave, 1919 (Fig. 28)

Synonym: *Neorhynchus tenellus* Van Cleave, 1913

Description (modified after Van Cleave 1913, 1919, and Petrochenko 1956a): body small, with both ends curved strongly ventrad, posterior half or two-thirds noticeably attenuated; hypodermis 15–25 μm thick; lemnisci about equal in length, 0.87 long; proboscis receptacle 0.26 long, with ganglion in middle of base; proboscis (Fig. 28b) short, subcylindrical, about 0.15 long, 0.135 wide, with three circles of six hooks each; hooks in adjacent rows alternating; apical hooks 90–110 μm long; median hooks 38 μm long; basal hooks 27 μm long.

Males: body 2–8 long, 0.280 wide; testes oval, 0.21 long, 0.12 wide; cement gland 0.26 long, 70 μm wide; cement reservoir sacciform.

Females (Fig. 28a): body 3.5–13.0 long, 0.280–0.60 in maximum diameter; eggs 37–45 μm long, 12–16 μm wide.

Site: intestine

Hosts: *Esox lucius* (1, 3); *E. masquinongy* (3); *Perca flavescens* (4); *Stizostedion canadense* (3); *S. vitreum vitreum* (2, 3, 4).

Records: 1. Bangham and Hunter 1939 (Ont); 2. Dechtiar 1972a (Ont); 3. 1972b (Ont); 4. Anthony 1978 (Ont).

Hooks of apical circle less than 90 μm in length; proboscis variable, less than 0.15 long 8

8 Testes and cement gland not contiguous; eggs large, 53–72 μm long, 26–31 μm wide .... *N. strigosus* Van Cleave, 1919 (Fig. 29)

Description (modified after Van Cleave 1949, Petrochenko 1956a, and Yamaguti 1963): sexual dimorphism marked, with males relatively small, weak, without anterior attenuation characteristic of females; lemnisci equal in size; apical organ conspicuous; some dorsal hypodermal nuclei narrow, extremely long (up to 1.0); proboscis (Fig. 29b) distinctly globular; male gonads apparently undergoing early degeneration.

Males (Fig. 29c): body 3.7–5.5 long, with maximum width 0.346, lacking ventrad flexion of females; proboscis 0.105 long, 0.146 wide, armed with hooks slightly smaller than corresponding hooks of females; genitalia usually occupying slightly more than 60% of trunk length; testes elongate, contiguous, relatively small; testicular degeneration leading to monorchid condition or complete loss of testes; cement gland elongate, narrow, usually a considerable distance posterior to posterior testis.

Females (Fig. 29a): body elongate, cylindrical, tapering posteriorly, attenuating anteriorly and flexed ventrad in conspicuously rounded curve of short radius, 9.0–14.1 long, 0.5–0.7 wide; proboscis spherical, 0.105–0.146 long, 0.132–0.158 wide; apical hooks of proboscis 53–64 μm long; median hooks 32–53 μm long; basal hooks 29–38 μm long; eggs 53–72 μm long, 25–31 μm wide.

Site: intestine

Hosts: *Catostomus catostomus* (1, 2); *C. commersoni* (1, 2, 3, 4, 5); *Esox lucius* (4, 5); *Oncorhynchus kisutch* (4, 5); *Perca flavescens* (6); *Stizostedion vitreum vitreum* (6).

Records: 1. Bangham 1955 (Ont); 2. Threlfall and Hanek 1970c (Lab); 3. Dechtiar 1972b (Ont); 4. Leong 1975 (Alta); 5. Leong and Holmes 1981 (Alta); 6. Poole and Dick 1985 (Man).

Testes and cement gland contiguous; eggs smaller 9

9 Proboscis nearly as long as wide ..... *N. rutili* (Müller, 1780) Hamann, 1892 (Fig. 30)

Description (modified after Van Cleave and Lynch 1950, Petrochenko 1956a, and Yamaguti 1963): body fusiform with greatest diameter at level of ventral giant nucleus, slightly arched ventrally; five giant nuclei along dorsal median line; one, rarely two, ventrally, about one-quarter trunk length from anterior end; lemnisci subequal in length, relatively short, one uninucleate, other binucleate; proboscis (Fig. 30b) subglobular, with three circles of 6 hooks each; apical hooks large, with roots; other hooks without roots; ganglion at base of proboscis receptacle.

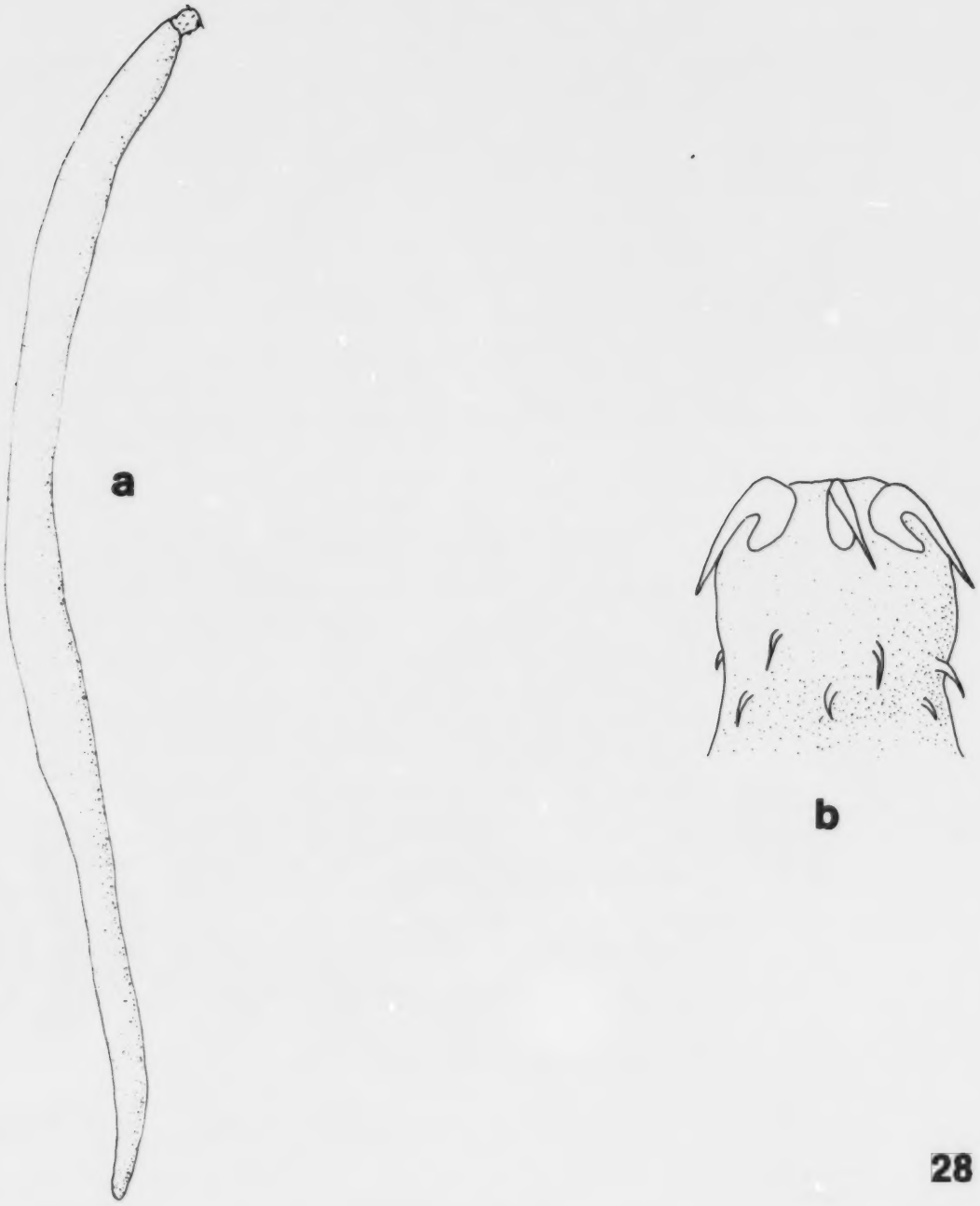

FIG. 28. *Neoechinorhynchus tenellus* [both redrawn after Van Cleave (1919)]: (a) surficial aspect of female; (b) proboscis.

29

FIG. 29. *Neoechinorhynchus strigosus* [all redrawn after Van Cleave (1949)]: (a) female; (b) proboscis; (c) male.

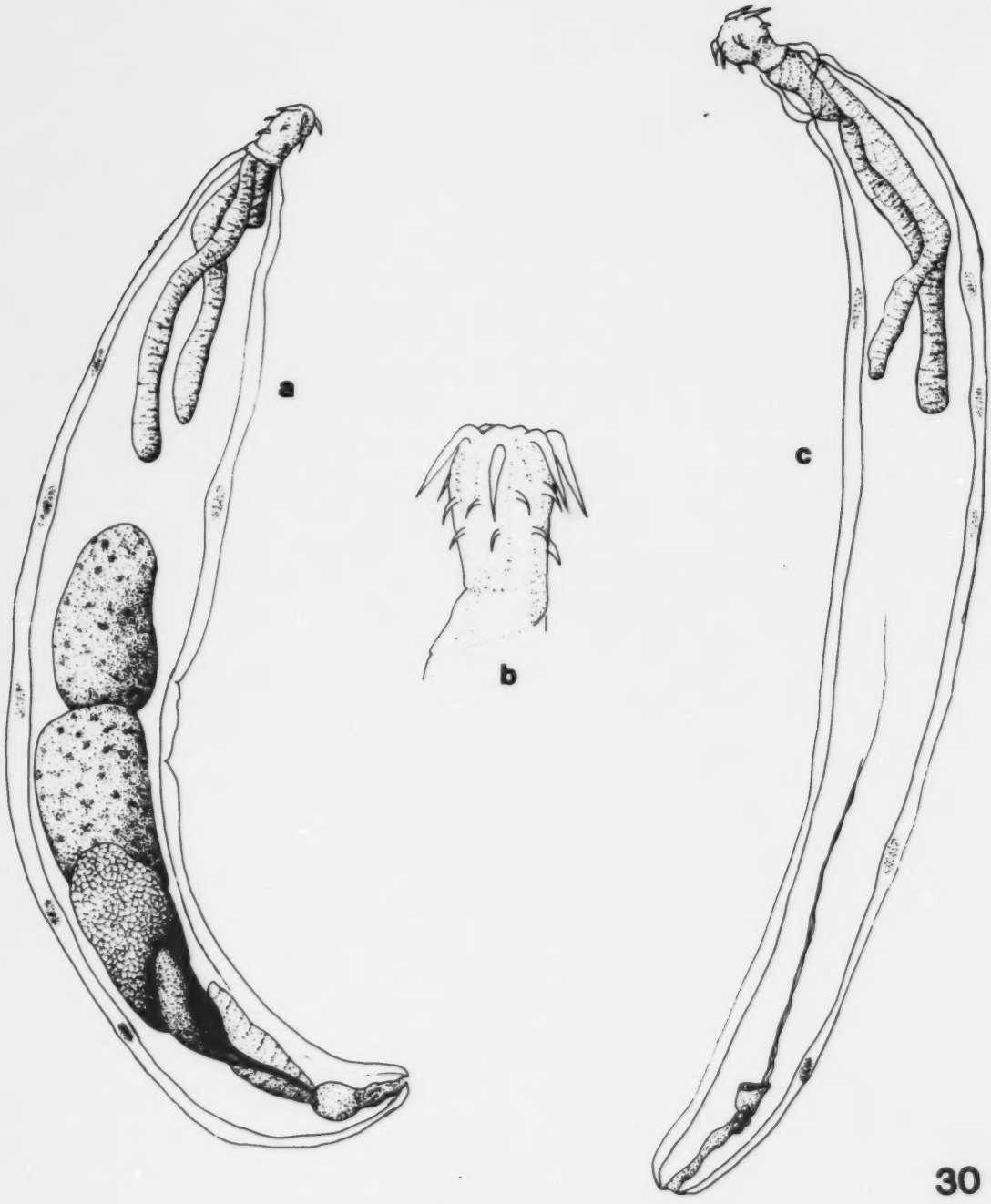

FIG. 30. *Neoechinorhynchus rutili* [all redrawn after Van Cleave and Lynch (1950)]: (a) male; (b) proboscis; (c) female.

Males (Fig. 30a): body 1.5–6.0 long, with maximum width 0.25–0.64; width at posterior end 0.30–0.41; proboscis 0.079–0.136 long, 0.079–0.12 wide; apical proboscis hooks 45–82 μm long, root 26–29 μm long; median hooks 26–44 μm long; basal hooks 19–34 μm long; proboscis receptacle 0.31 long, 0.09 wide; uninucleate lemniscus 1.10–1.18 long; binucleate lemniscus up to 1.41 long; width of each lemniscus 0.094; testes slightly elongated, contiguous, subequal in size; with anterior testis slightly larger than posterior, 0.55–0.67 long, 0.33–0.34 wide; cement gland syncytial, about 0.78 long, nearly of same diameter as testes, slightly longer than wide; cement ducts relatively short, not much longer than cement reservoir; bursa relatively weak, without heavy musculature, cement reservoir rounded, overlapped by posterior testis.

Females (Fig. 30c): body 2.1–10.0 long, maximum width 0.30–0.83; width posteriorly 0.44–0.45; proboscis 0.09–0.252 long, 0.093–0.132 wide; apical proboscis hooks 52–84 μm long, with root 29–35 μm long; median hooks 29–46 μm long; basal hooks 22–34 μm long; lemnisci 2.30–2.33 long, subequal in length; smaller lemniscus uninucleate; larger binucleate; eggs oval, 30–45 μm long, 14–32 μm wide; gonopore near ventral margin of obliquely truncated posterior end; dorsal and ventral ligament sacs with developing embryos.

Site: intestine

Hosts: *Catostomus catostomus* (2, 22); *C. commersoni* (2); *C. macrocheilus* (2); *Coregonus clupeaformis* (23, 28); *Cottus asper* (2); *C. bairdi* (10); *C. cognatus* (21); *C. rhotheus* (2); *Couesius plumbeus* (2 (as *Couesius plumbeus greeni*)); *Culaea inconstans* (3, 11); *Esox lucius* (2, 3, 21); *Fundulus heteroclitus* (17); *Gasterosteus aculeatus* (1, 2, 9, 18); *Ictalurus nebulosus* (2 (as *Ameiurus nebulosus*)); *Lota lota* (2, 3 (as *Lota maculosa*), 21, 23, 28); *Micropterus dolomieui* (3); *Morone saxatilis* (31); *Mylocheilus caurinus* (2); *Notropis hudsonius* (3, 10); *Oncorhynchus keta* (7, 8); *O. kisutch* (2, 7, 8); *O. nerka* (1, 2, 4, 5, 6, 8, 12, 23, 26, 28); *O. tshawytscha* (7); *Osmerus mordax* (12); *Perca flavescens* (3, 10, 12); *Prosopium coulteri* (28); *P. williamsoni* (2, 21, 23, 28, 29, 30); *Ptychocheilus oregonensis* (1, 2, 21, 23, 28, 29, 30); *Pungitius pungitius* (1, 3, 17, 19, 27); *Richardsonius balteatus* (2, 23, 28, 29, 30); *Salmo clarki* (1, 2); *S. gairdneri* (2 (as *Salmo gairdneri kamloops*), 23, 28, 29, 30); *S. salar* (13, 14, 15, 16, 20); *Salvelinus alpinus* (24, 25, 32); *S. fontinalis* (1, 2); S. *malma* (2 (as *Salvelinus alpinus malma*), 7, 23, 27, 28,); *S. namaycush* (21, 23, 28, 29); *Stizostedion vitreum vitreum* (33); *Thymallus arcticus* (21, 23, 28); *Umbra limi* (3).

Records: 1. Van Cleave and Lynch 1950 (BC); 2. Bangham and Adams 1954 (BC); 3. Bangham 1955 (Ont); 4. Margolis 1956 (BC); 5. 1957 (Pac); 6. 1963 (Pac); 7. Arai 1967 (Pac); 8. 1969 (Pac); 9. Hanek and Threlfall 1970a (Lab); 10. Dechtiar 1972a (Ont); 11. 1972b (Ont); 12. Collins and Dechtiar 1974 (Ont); 13. Hare and Frantsi 1974 (NB); 14. Hare 1975 (NB); 15. Hare and Burt 1975a (NB); 16. 1975b (NB); 17. Dickinson and Threlfall 1975 (Nfld); 18. Lester 1975 (BC); 19. Dickinson and Threlfall 1976 (Nfld); 20. Hare and Burt 1976 (NB); 21. Arthur et al. 1976 (YT); 22. Mudry and Anderson 1977 (Alta); 23. Anonymous 1978 (BC); 24. Curtis 1979 (NWT); 25. Dick and Belosevic 1981 (NWT); 26. Simpson et al. 1981 (BC); 27. Curtis 1982 (NWT); 28. Arai and Mudry 1983 (BC); 29. Anonymous 1983 (BC); 30. 1984 (BC); 31. Hogans 1984 (NB); 32. Dick 1984 (NWT); 33. Poole and Dick 1985 (Man).

Proboscis wider than long 10

10 Eggs oval, small, 22–35 μm long; hooks of apical circle 49–64 μm long .... *N. salmonis* Ching, 1984 (Fig. 31)

Description (modified after Ching 1984): with the characters of the genus.

Males (Fig 31a): body cylindrical, curved ventrad especially posteriorly, truncated at both ends, 4.5–7.8 long, 0.6–1.1 wide at level of ventral hypodermal nucleus; proboscis (Fig. 31b) wider than long, 0.08–0.12 long, 0.9–0.15 wide, armed with three circles of six hooks each; apical hooks with roots, equal in size, 49–64 μm long; median hooks 29–36 μm long; basal hooks 20–26 μm long; neck variable in length; proboscis receptacle elongate, thin-walled, 0.25–0.27 long, 0.04–0.17 wide; lemnisci subequal in length, extending posteriorly to level between first dorsal and ventral hypodermal nuclei; uninucleate lemniscus 0.75–0.92 long, 0.06–0.18 wide; binucleate lemniscus 0.70–1.82 long, 0.06–0.21 wide; testes ovoid, tandem, contiguous; anterior testis 0.68–1.60 long, 0.19–0.61 wide; posterior testis 0.53–1.41 long, 0.20–0.43 wide; cement gland ovoid, overlapping posterior testes, varying greatly in size, often larger than posterior testis, 0.35–1.112 long, 0.26–0.43 wide; cement reservoir small,

FIG. 31. *Neoechinorhynchus salmonis* [all redrawn after Ching (1984)]: (a) male; (b) proboscis; (c) female.

rounded, overlapping cement gland; seminal vesicle elongate, with ducts opening separately into genital bursa; Saefftigen's sac underlying ducts of seminal vesicle and cement gland; genital bursa with muscular edges; reproductive organs occupying posterior four-fifths of trunk in extended individuals. Females (Fig. 31c): body cylindrical, with truncated ends, 5.8–14.5 long, 0.6–1.6 wide at level of ventral hypodermal nucleus; proboscis subspherical, 0.09–0.12 long, 0.10–0.16 wide, armed with three circles of six hooks each; apical hooks of uniform size, with roots, 56–71 μm long; median hooks 28–40 μm long; basal hooks 22–34 μm long; lemnisci subequal in length, extending posteriorly to level between first dorsal and ventral hypodermal nuclei; uninucleate lemniscus 0.76–1.84 long, 0.08–0.20 wide; binucleate lemniscus 0.70–1.82 long, 0.07–0.19 wide; ovarian balls filling most of body cavity; uterine bell lined with large cells, joined posteriorly by two dorsal processes; three- to four-lobed selective apparatus; uterus lined with thick muscles, ending in a short sphincter; vagina short, muscular, terminating with a sphincter; eggs ovoid 22–35 μm long, 10–23 μm wide.

Sites: intestine, pyloric ceca

Hosts: *Catostomus catostomus* (1, 2, 3); *C. macrocheilus* (2, 3); *Coregonus clupeaformis* (1, 2); *Cottus asper* (1, 2, 3); *Lota lota* (2, 3); *Mylocheilus caurinus* (1, 2); *Oncorhynchus kisutch* (2); *O nerka* (1, 2, 3); *O. tshawytscha* (2); *Prosopium williamsoni* (1, 2, 3); *Ptychocheilus oregonensis* (1, 2, 3); *Salmo gairdneri* (1, 2, 3); *Salvelinus malma* (3); *S. namaycush* (1, 2); unspecified salmonid fishes (3).

Records: 1. Anonymous 1983 (BC); 2. Anonymous 1984 (BC); 3. Ching 1984 (BC).

Remarks: Anonymous (1983) introduced the name *Neoechinorhynchus salmonis* without a description or illustrations; Anonymous (1984) used the same combination and added 'Ching, 1983' i.e., '*Neoechinorhynchus salmonis* Ching, 1983'. Ching (1984) described *Neoechinorhynchus salmonis* but without reference to either of the earlier usages. I have assumed that '*Neoechinorhynchus salmonis*', '*Neochinorhynchus salmonis* Ching, 1983' and *Neoechinorhynchus salmonis* Ching, 1984 are conspecific and have listed the hosts and distributions collectively.

Eggs elongate, larger, 44–61 μm long; hooks of apical circle 58–97 μm long 11

11 Trunk tapering gradually anteriorly; proboscis greater than 0.14 in width; eggs greater than 47 μm long ..... *N. cylindratus* (Van Cleave, 1913) Van Cleave, 1919 (Fig. 32)

Synonyms: *Neorhynchus cylindratus* Van Cleave, 1913; *Eorhynchus cylindratus* (Van Cleave, 1913) Van Cleave, 1914

Description (modified after Van Cleave 1913, 1914, 1919, 1924, Ward 1940, Petrochenko 1956a, and Yamaguti 1963): body large, subcylindrical (except in young forms with tapering posterior extremity); five giant hypodermal nuclei in mid-dorsal line and one in mid-ventral line; maximum diameter of trunk just caudad of end of lemnisci; proboscis hooks in three circles of six hooks each (Fig. 32b), alternating in adjacent rows; roots of apical hooks relatively large, of median hooks smaller, of basal hooks rudimentary; lemnisci straight, saccular, one-sixth to one-quarter of length of body cavity; proboscis receptacle about 0.45 long, single-walled, with ganglion at middle of base.

Males (Fig. 32c): body 4.5–8.5 long, 0.36–0.70 wide; thickness of body wall 0.02–0.05; proboscis subspherical, 0.10–0.149 long, 0.150–0.172 wide; apical proboscis hooks large, with blade 48–97 μm long, sharply recurved, 14 μm thick at base, root 58 μm long, 19 μm wide; median hooks 24–37 μm long, 5 μm wide at base; basal hooks 17–25 μm long, 3 μm wide at base; proboscis receptacle 0.24–0.35 long, 0.13–0.14 wide; binucleate lemniscus 0.84–1.2 long; uninucleate lemniscus 0.74–1.05 long; testes contiguous; anterior testis 0.40–0.70 long, 0.18–0.26 wide; posterior testis 0.21–0.55 long, 0.17–0.27 wide; syncytial cement gland rectangular; with eight giant nuclei, 0.67–1.2 long, 0.13–0.67 wide; cement reservoir about 35 μm long.

Females (Fig. 32a): body 7.0–15.0 long, 0.35–0.70 in diameter, just caudad of proboscis; proboscis subspherical, 0.10–0.14 long, 0.16–0.19 wide; apical hooks 61–88 μm long; median hooks 24–40 μm long; basal hooks 17–27 μm long; ganglion at base of receptacle; binucleate lemniscus 0.95–1.4 long; uninucleate lemniscus 0.85–1.34 long; eggs elliptical, 49–61 μm long, 15–28 μm wide; gonopore ventral, subterminal.

Site: intestine

Hosts: *Ambloplites rupestris* (6, 10); *Catostomus commersoni* (2); *Coregonus clupeaformis* (7, 11, 13); *Esox lucius* (6, 15); *E. masquinongy* (5, 15); *Etheostoma nigrum* (6, (as *Boleosoma nigrum*)); *Lepomis gibbosus* (6); *Lota lota* (6 (as *Lota maculosa*)); *Micropterus dolomieui* (1, 3, 4, 6, 10); *M. salmoides* (1 (as *Aplites salmoides*), 6); *Perca flavescens* (6, 7, 8, 9 (as *Perca fluviatilis*)); *Pomoxis nigromaculatus* (6); *Richardsonius*

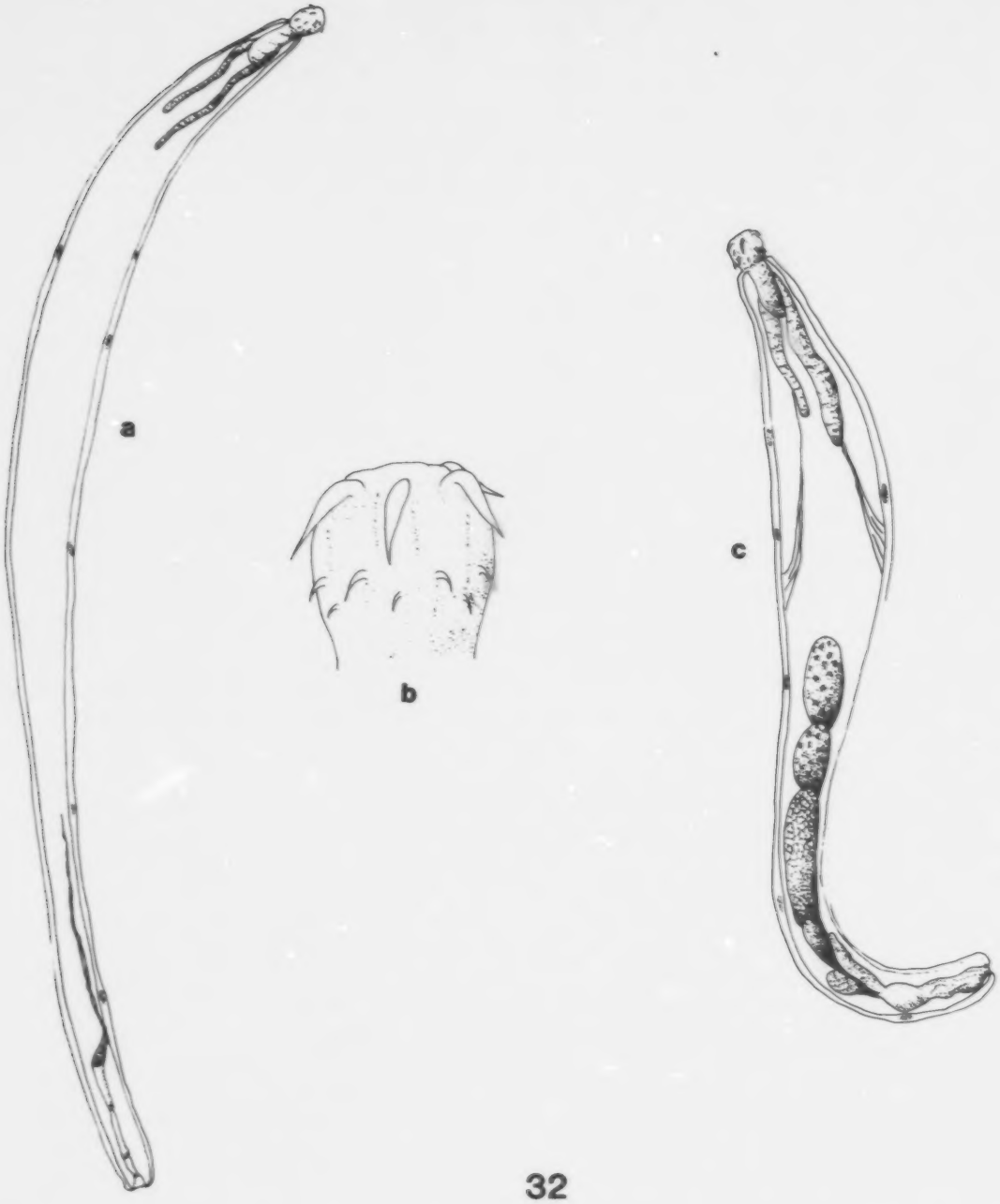

FIG. 32. *Neoechinorhynchus cylindratus* [all redrawn after Ward (1940)]: (a) female; (b) proboscis; (c) male.

balteatus (12, 14); *Salvelinus fontinalis* (2); *Stizostedion canadense* (6); *S. vitreum vitreum* (1, 6, 7); unspecified centrarchid fishes (16).

Records: 1. Bangham and Hunter 1939 (Ont); 2. Lyster 1940 (Que); 3. Bangham 1941 (Ont); 4. Bangham and Venard 1946 (Ont); 5. Choquette 1951 (Que); 6. Bangham 1955 (Ont); 7. Dickson 1964 (Man); 8. Tedla and Fernando 1969 (Ont); 9. 1972 (Ont); 10. Dechtiar 1972b (Ont); 11. Watson 1977 (Man); 12. Anonymous 1978 (BC); 13. Watson and Dick 1979 (Man); 14. Arai and Mudry 1983 (BC); 15. Anthony 1983 (Ont); 16. 1985 (Ont).

Remarks: Centrarchids examined by Anthony (1985) included *Ambloplites rupestris*, *Lepomis gibbosus*, *L. macrochirus*, *Micropterus dolomieui*, *M. salmoides*, and *Pomoxis nigromaculatus*.

Trunk robust anteriorly; proboscis less than 0.14 wide, flexed ventrad; eggs less than 47 μm long ..... *N. saginatus* Van Cleave and Bangham, 1949 (Fig. 33)

Description (modified after Van Cleave and Bangham 1949, Petrochenko 1956a, and Yamaguti 1963): body robust, with relatively thick walls; sexual dimorphism pronounced, especially in body dimensions; proboscis of both sexes flexed ventrad, forming an angle with longitudinal trunk axis; proboscis and armature similar in both sexes (Fig. 33b); proboscis 0.105–0.109 long, 0.079–0.139 wide, armed with three circles of six hooks each; apical hooks 58–67 μm long, 16 μm wide at junction of blade and root; median hooks 31–38 μm long; basal hooks 27–32 μm long.

Males (Fig. 33a): body up to 8.0 long, 0.70–2.4 wide; genitalia in posterior third of trunk.

Females (Fig. 33c): body often up to 20.0 long, 1.2–2.1 wide at level of second dorsal hypodermal nucleus, tapering gradually posteriorly, with anterior extremity somewhat enlarged; eggs 44–46 μm long, 16–20 μm wide.

Site: intestine

Hosts: *Catostomus catostomus* (1); *C. commersoni* (2); *C. macrocheilus* (1); *Hypentelium nigricans* (2); *Lota lota* (1); *Oncorhynchus kisutch* (1); *O. nerka* (1); *O. tshawytscha* (1); *Prosopium williamsoni* (1); *Ptychocheilus oregonensis* (1); *Salmo gairdneri* (1); *Semotilus atromaculatus* (2).

Records: 1. Anonymous 1981 (BC); 2. Mackie et al. 1983 (Ont).

Neoechinorhynchus sp.

Site: intestine

Hosts: *Aplodinotus grunniens* (14); *Carpiodes cyprinus* (5); *Catostomus catostomus* (6); *C. commersoni* (3, 8, 12, 13); *Coregonus artedii* (1 (as *Leucichthys artedii*)); *Fundulus diaphanus* (2); *Notropis atherinoides* (11); *N. hudsonius* (11); *Oncorhynchus keta* (18); *O. nerka* (17); *Perca flavescens* (10); *Percopsis omiscomaycus* (9); *Pimephales notatus* (11); *Prosopium williamsoni* (15, 16); *Richardsonius balteatus* (14, 15); *Salmo gairdneri* (14, 15); *Salvelinus namaycush* (15, 16); *Semotilus atromaculatus* (3, 4); *Stizostedion canadense* (2); *S. vitreum vitreum* (7).

Records: 1. Pritchard 1931 (Ont); 2. Bangham and Hunter 1939 (Ont); 3. Bangham 1941 (Ont); 4. Bangham and Venard 1946 (Ont); 5. Stewart-Hay 1951b (Man); 6. Rawson 1951 (NWT); 7. Stewart-Hay 1952a (Man); 8. 1952b (Man); 9. Bangham 1955 (Ont); 10. Dechtiar 1972a (Ont); 11. 1972b (Ont); 12. Mudry and Arai 1973 (Alta); 13. Mudry and Anderson 1976 (Alta); 14. Anthony 1982 (Ont); 15. Anonymous 1983 (BC); 16. 1984 (BC); 17. Groot et al. 1984 (BC); 18. Whitaker 1986 (BC).

Octospiniferoides Bullock, 1957 (Fig. 34)

Diagnosis (modified after Bullock 1957, 1966): body small, not very elongate, similar in both sexes, males (Fig. 34c) smaller than females (Fig. 34a); proboscis (Fig. 34b) spherical, armed with three circles of 8–10 hooks each; all hooks small, slender, with prominent roots; roots longer than blade of all hooks; proboscis receptacle thin-walled, with small invertor muscle and ganglion proportionately large; latter located posteriorly; two prominent ganglion cells between receptacle ganglion and apical organ; proboscis retractor muscles long, simple, attached to body wall near third dorsal giant hypodermal nucleus in both sexes; lemnisci two to three times length of receptacle, slender, convoluted, approximately equal in length; female gonopore subterminal.

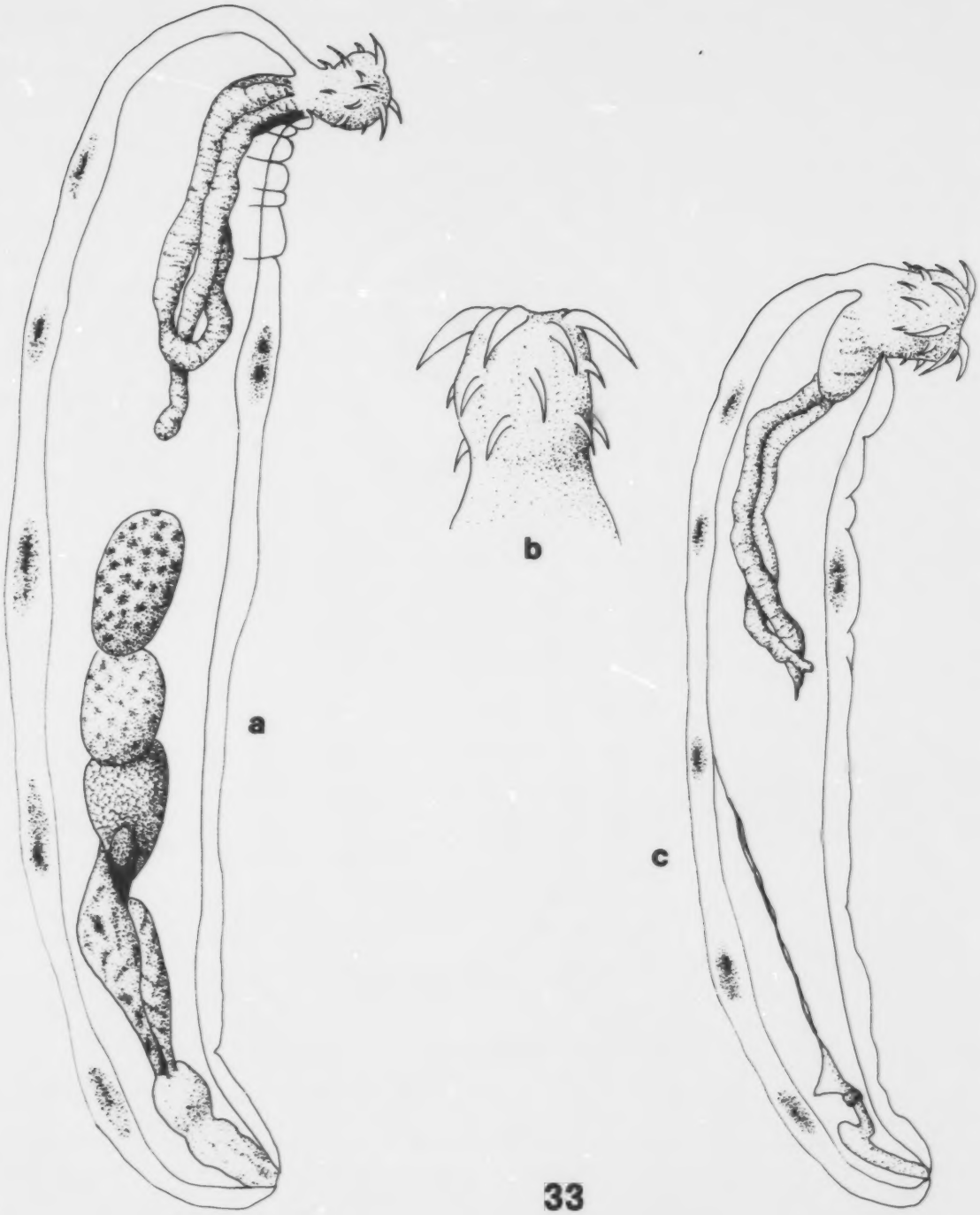

FIG. 33. *Neoechinorhynchus saginatus* [all redrawn after Van Cleave and Bangham (1949)]: (a) male; (b) proboscis; (c) female.

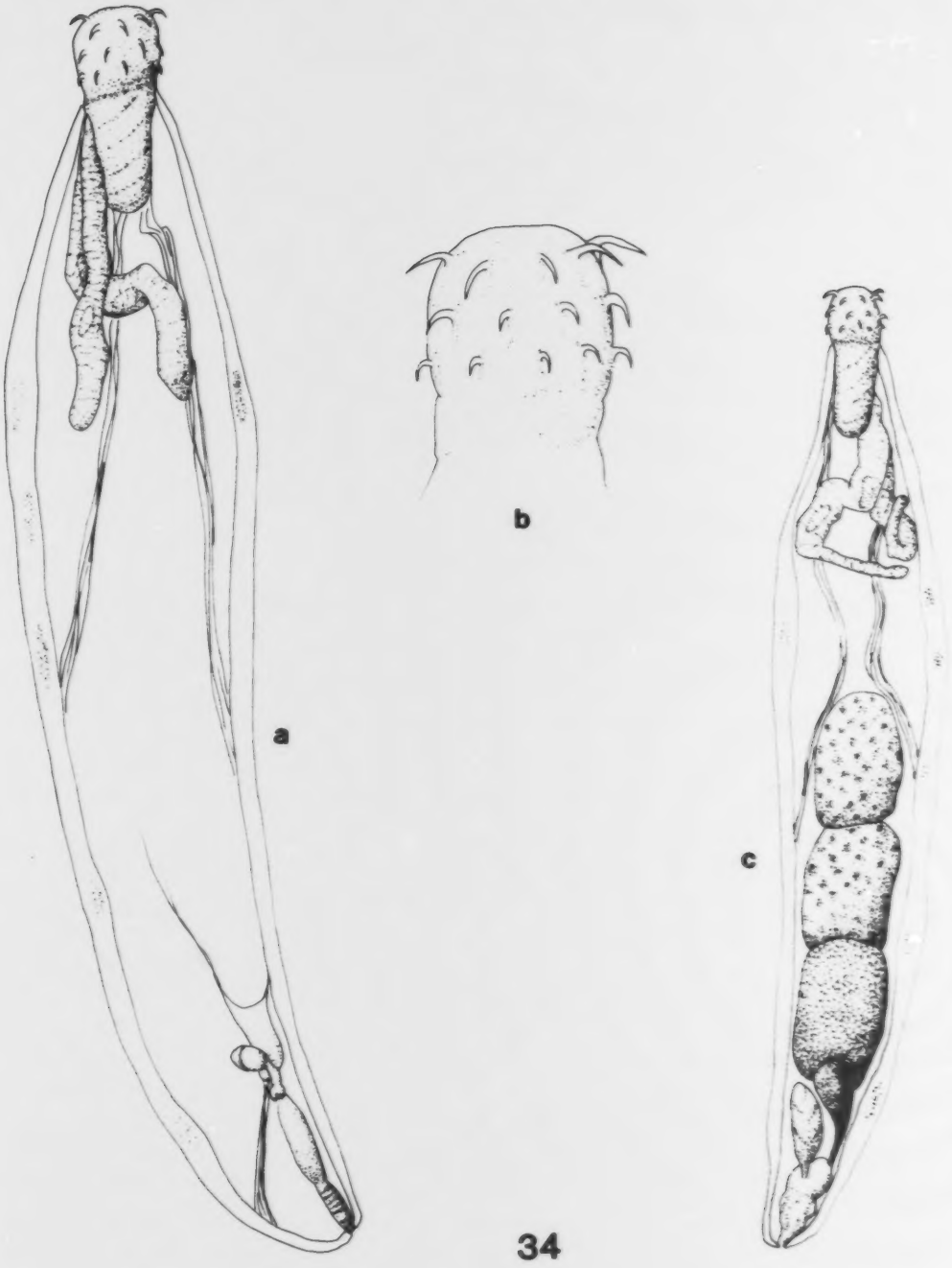

FIG. 34. *Octospiniferoides chandleri* [all redrawn after Bullock (1966)]: (a) female; (b) proboscis; (c) male.

One species in freshwater fishes of Canada.

Octospiniferoides sp.

Site: intestine

Host: *Fundulus diaphanus*.

Record: Wiles 1975 (NS).

Note: The illustration (Fig. 34) is of *Octospiniferoides chandleri* Bullock, 1957 and not taken from this record.

Octospinifer Van Cleave, 1919

Diagnosis (modified after Van Cleave 1919, Petrochenko 1956a, and Yamaguti 1963): body delicate, thin-walled, subcylindrical, tapering posteriorly; hypodermal nuclei giant, mainly in mid-dorsal line of trunk; lacunar system with prominent mid-dorsal longitudinal canal, with reticular anastomoses; proboscis short, spherical, slightly wider than long, armed with three circles of 8–10 hooks each; proboscis receptacle subcylindrical, short, with ganglion near base; lemnisci tubular, moderately long, one binucleate, other uninucleate; testes elliptical, contiguous, in mid-third of trunk; cement gland syncytial, with several giant nuclei, apart from testes; eggs elliptical, with delicate membranes.

One species in freshwater fishes of Canada.

Octospinifer macilentus Van Cleave, 1919 (Fig. 35)

Synonyms: *Octospinifer* sp. *sensu* Arai and Mudry, 1973; *Octospinifer* sp. *sensu* Mudry and Anderson, 1976

Description (modified after Van Cleave 1919, Petrochenko 1956a, and Yamaguti 1963): body long, subcylindrical, tapering slightly posteriorly; proboscis (Fig. 35a) short, spherical, usually wider than long, 0.106 long, 0.12 wide, armed with three circles of 8–10 hooks each; apical hooks equal in size, 41 μm long; median hooks 22–35 μm long; basal hooks 24–30 μm long.

Males (Fig. 35b): body about 4.0 long; testes elliptical, not contiguous; sperm ducts with vesicular enlargements between posterior margin of anterior testis and anterior margin of cement gland; cement gland quite distant from posterior testis, with eight giant nuclei; gonopore terminal.

Females: body about 10.0 long, with maximum width 0.4 (but up to 0.58 in gravid individuals); posterior extremity of trunk about 0.19 wide; gonopore subterminal, ventral, about 0.10 from posterior tip; eggs 30–47 μm long, 15–18 μm wide.

Site: intestine

Hosts: *Catostomus catostomus* (2, 12, 13); *C. commersoni* (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13); *C. macrocheilus* (12, 13).

Records: 1. Bangham and Hunter 1939 (Ont); 2. Bangham 1941 (Ont); 3. Bangham and Venard 1946 (Ont); 4. Van Cleave 1949 (Ont); 5. Bangham 1955 (Ont); 6. Arai and Kussat 1967 (Alta); 7. Kussat 1969 (Alta); 8. Dechtiar 1972b (Ont); 9. Beermann 1972 (Alta); 10. Beermann, et al. 1974 (Alta); 11. Mudry and Anderson 1976 (Alta); 12. Anonymous 1978 (BC); 13. Arai and Mudry 1983 (BC).

Records of Acanthocephala gen. sp.

Sites: intestine, mesenteries, coelom

Hosts: *Aplodinotus grunniens* (3); *Carpiodes cyprinus* (7); *Catostomus commersoni* (7, 8); *Coregonus clupeaformis* (12); *Ictalurus nebulosus* (3 (as *Ameiurus nebulosus*)); *Macrozoarces americanus* (6); *Moxostoma macrolepidotum* (7 (as *Moxostoma aureolum*)); *Notropis cornutus* (5); *N. heterolepis* (5); *Oncorhynchus tshawytscha* (9); *Perca flavescens* (3); *Platichthys stellatus* (10); *Salmo gairdneri* (4); *S. salar* (4); *Salvelinus alpinus* (11); *S. fontinalis* (1, 2, 4); *S. namaycush* (12); *Sebastes fasciatus* (13); *S. marinus* (13); *Stizostedion canadense* (3); *S. vitreum vitreum* (3, 7).

Records: 1. Ricker 1932 (Ont, Que); 2. Richardson 1935 (Que); 3. Bangham and Hunter 1939 (Ont); 4. Frost 1940 (Nfld); 5. Bangham 1941 (Ont); 6. Olsen and Merriman 1946 (Atl); 7. Stewart-Hay 1951b (Man); 8. 1952a (Man); 9. Godfrey 1968 (Pac); 10. Robinson et al. 1968 (Pac); 11. Dick and Belosevic 1978 (NWT); 12. McAllister and Mudry 1983 (Alta); 13. Bourgeois and Ni 1984 (Atl).

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FIG. 35. *Octospinifer macilentus* [both redrawn after Van Cleave (1919)]: (a) proboscis; (b) male.

HOST-PARASITE LIST

CLASS AGNATHA

ORDER PETROMYZONTIFORMES

Family PETROMYZONTIDAE

Petromyzon marinus Linnaeus — sea lamprey
Echinorhynchus salmonis (Ont)

CLASS CHONDRICHTHYES

ORDER RAJIFORMES

Family RAJIDAE

Raja radiata Donovan — thorny skate
Echinorhynchus gadi (Atl)

CLASS OSTEICHTHYES

ORDER ACIPENSERIFORMES

Family ACIPENSERIDAE

Acipenser brevirostrum Lesueur — shortnose sturgeon
Fessisentis friedi (NB)

Acipenser fulvescens Rafinesque — lake sturgeon
Echinorhynchus salmonis (Ont)

Acipenser oxyrhynchus Mitchill — Atlantic sturgeon
Echinorhynchus gadi (NB)
Echinorhynchus sp. (NB)

Acipenser transmontanus Richardson — white sturgeon
Corynosoma strumosum (BC)

ORDER SEMIONOTIFORMES

Family LEPISOSTEIDAE

Lepisosteus osseus (Linnaeus) — longnose gar
Leptorhynchoides thecatus (Ont)

ORDER AMIIFORMES

Family AMIIDAE

Amia calva Linnaeus — bowfin
Leptorhynchoides thecatus (Ont)
Pomphorhynchus bulbocolli (Ont)

ORDER ANGUILLIFORMES

Family ANGUILLIDAE

Anguilla rostrata (Lesueur) — American eel
Echinorhynchus lateralis (Nfld, Lab)
Leptorhynchoides thecatus (Ont)

ORDER CLUPEIFORMES

Family CLUPEIDAE

Alosa pseudoharengus (Wilson) — alewife
Acanthocephalus dirus (Ont)
Echinorhynchus salmonis (Ont)

Clupea harengus harengus Linnaeus — Atlantic herring
Echinorhynchus gadi (Atl)

Clupea harengus pallasi Valenciennes — Pacific herring
Corynosoma strumosum (juvenile) (Pac)
Corynosoma villosum (juvenile) (Pac)
Echinorhynchus gadi (Pac)
Rhadinorhynchus trachuri (Pac)

ORDER OSTEOGLOSSIFORMES

Family HIODONTODAE

Hiodon tergisus Lesueur — mooneye
Pomphorhynchus bulbocolli (Man, Ont)

ORDER SALMONIFORMES

Family SALMONIDAE

Coregonus alpenae (Koelz) — longjaw cisco
Echinorhynchus salmonis (Ont)

Coregonus artedii Lesueur — cisco, lake herring
Echinorhynchus lateralis (Ont)
Echinorhynchus salmonis (Alta, Man, Ont)
Neoechinorhynchus tumidus (Sask, Ont)
Neoechinorhynchus sp. (Ont)
Pomphorhynchus bulbocolli (Alta, Man)

Coregonus autumnalis — Arctic cisco
Echinorhynchus leidyi

Coregonus clupeaformis (Mitchill) — lake whitefish
Acanthocephalus dirus (Ont)
Echinorhynchus lateralis (Ont, Nfld, Lab)
Echinorhynchus leidyi (Ont)
Echinorhynchus salmonis (Alta, Man, Ont)
Echinorhynchus sp. (Ont)
Leptorhynchoides thecatus (Ont)
Neoechinorhynchus cylindratus (Man)
Neochinorhynchus salmonis (BC)
Neoechinorhynchus rutili (BC)
Neoechinorhynchus tumidus (YT, Sask, Ont)
Pomphorhynchus bulbocolli (BC, Alta, Man)
Pomphorhynchus sp. (Man)

Coregonus hoyi (Gill) — bloater
Echinorhynchus leidyi (Ont)
Echinorhynchus salmonis (Ont)
Neoechinorhynchus tumidus (Ont)

Coregonus reighardi (Koelz) — shortnose cisco
Echinorhynchus sp. (Ont)

Coregonus sardinella Valenciennes — least cisco
- *Echinorhynchus leidyi* (Man, NWT)
- *Echinorhynchus salmonis* (NWT)

Coregonus sp.
- *Echinorhynchus salmonis* (NWT)

Oncorhynchus gorbuscha (Walbaum) — pink salmon
- *Bolbosoma caenoforme* (juvenile) (Pac, BC)
- *Corynosoma strumosum* (juvenile) (Pac)
- *Corynosoma* sp. (juvenile) (Pac)
- *Echinorhynchus gadi* (Pac, BC)
- *Rhadinorhynchus trachuri* (BC)

Oncorhynchus keta (Walbaum) — chum salmon
- *Echinorhynchus gadi* (Pac, BC)
- *Neoechinorhynchus rutili* (Pac)
- *Neoechinorhynchus* sp. (BC)

Oncorhynchus kisutch (Walbaum) — coho salmon
- *Corynosoma* sp. (juvenile) (Pac)
- *Echinorhynchus gadi* (Pac, BC)
- *Echinorhynchus salmonis* (Alta, Ont)
- *Neoechinorhynchus rutili* (Pac, BC)
- *Neoechinorhynchus saginatus* (BC)
- *Neoechinorhynchus salmonis* (BC)
- *Neoechinorhynchus strigosus* (Alta)
- *Pomphorhynchus bulbocolli* (BC, Alta)
- *Rhadinorhynchus trachuri* (Pac, BC)

Oncorhynchus nerka (Walbaum) — sockeye salmon
- *Acanthocephalus dirus* (Ont)
- *Bolbosoma caenoforme* (juvenile) (Pac, BC)
- *Corynosoma strumosum* (juvenile) (Pac)
- *Corynosoma villosum* (juvenile) (Pac)
- *Echinorhynchus gadi* (Pac, BC)
- *Echinorhynchus salmonis* (Ont)
- *Leptorhynchoides thecatus* (Ont)
- *Neoechinorhynchus pungitius* (Ont)
- *Neoechinorhynchus rutili* (Pac, BC, Ont)
- *Neoechinorhynchus saginatus* (BC)
- *Neoechinorhynchus salmonis* (BC)
- *Neoechinorhynchus tumidus* (Ont)
- *Neoechinorhynchus* sp. (BC)
- *Pomphorhynchus bulbocolli* (Ont)
- *Rhadinorhynchus trachuri* (Pac, BC)

Oncorhynchus tshawytscha (Walbaum) — chinook salmon
- *Echinorhynchus gadi* (Pac, BC)
- *Echinorhynchus salmonis* (Ont)
- *Neoechinorhynchus rutili* (Pac)
- *Neoechinorhynchus saginatus* (Ont)
- *Neoechinorhynchus salmonis* (BC)
- Acanthocephala gen. sp. (Pac)

Prosopium coulteri (Eigenmann and Eigenmann) — pigmy whitefish
- *Neoechinorhynchus rutili* (BC)

Prosopium cylindraceum (Pallas) — round whitefish
- *Echinorhynchus lateralis* (Lab)
- *Echinorhynchus salmonis* (Ont)
- *Neoechinorhynchus tumidus* (YT)

Prosopium williamsoni (Girard) — mountain whitefish
- *Neoechinorhynchus rutili* (YT, BC)
- *Neoechinorhynchus saginatus* (BC)
- *Neoechinorhynchus salmonis* (BC)
- *Neoechinorhynchus tumidus* (YT, Ont)
- *Neoechinorhynchus* sp. (BC)
- *Pomphorhynchus bulbocolli* (BC)

Salmo clarki Richardson — cutthroat trout
- *Neoechinorhynchus rutili* (BC)
- *Pomphorhynchus bulbocolli* (BC)

Salmo gairdneri Richardson — rainbow trout
- *Echinorhynchus lateralis* (Nfld)
- *Echinorhynchus leidyi* (Ont)
- *Echinorhynchus salmonis* (Ont)
- *Neoechinorhynchus rutili* (BC)
- *Neoechinorhynchus saginatus* (BC)
- *Neoechinorhynchus salmonis* (BC)
- *Neoechinorhynchus* sp. (BC)
- *Pomphorhynchus bulbocolli* (BC)
- Acanthocephala gen. sp. (Nfld)

Salmo salar Linnaeus — Atlantic salmon
- *Echinorhynchus gadi* (Que, NS, Atl)
- *Echinorhynchus lateralis* (Ont, NB, NS, Nfld, Lab)
- *Echinorhynchus* sp. (NS, Nfld, Lab, PEI, Atl)
- *Neoechinorhynchus rutili* (NB)
- *Pomphorhynchus bulbocolli* (NB, NS)
- Acanthocephala gen. sp. (Nfld)

Salmo trutta Linnaeus — brown trout
- *Echinorhynchus lateralis* (Nfld)

Salvelinus alpinus (Linnaeus) — Arctic char
- *Corynosoma* sp. (juvenile) (NWT)
- *Echinorhynchus gadi* (NWT, Que)
- *Echinorhynchus leidyi* (Man, NWT)
- *Echinorhynchus lateralis* (Lab)
- *Echinorhynchus salmonis* (NWT)
- *Echinorhynchus* sp. (NWT, Que)
- *Neoechinorhynchus rutili* (BC, NWT)
- Acanthocephala gen. sp. (NWT)

Salvelinus fontinalis (Mitchill) — brook trout
- *Echinorhynchus gadi* (Que, Atl)
- *Echinorhynchus lateralis* (Que, NB, NS, Nfld, Lab)
- *Echinorhynchus* sp. (Que, Lab)
- *Leptorhynchoides thecatus* (Ont)
- *Neoechinorhynchus cylindratus* (Que)
- *Neoechinorhynchus rutili* (Que)
- Acanthocephala gen. sp. (Ont, Que, Nfld)

Salvelinus fontinalis (Mitchill) × *S. namaycush* (Walbaum) — splake
- *Acanthocephalus dirus* (Ont)
- *Echinorhynchus salmonis* (Ont)
- *Neoechinorhynchus tumidus* (Ont)
- *Pomphorhynchus bulbocolli* (Ont)

Salvelinus malma (Walbaum) Dolly Varden
Echinorhynchus gadi (Pac)
Echinorhynchus leidyi (NWT, Ont)
Echinorhynchus salmonis (NWT)
Neoechinorhynchus rutili (Pac, BC)
Neoechinorhynchus salmonis (BC)

Salvelinus namaycush (Walbaum) lake trout
Echinorhynchus gadi (E Arc, W Arc)
Echinorhynchus lateralis (Lab)
Echinorhynchus leidyi (NWT, Ont, Que)
Echinorhynchus salmonis (NWT, Alta, Man, Ont)
Leptorhynchoides thecatus (Ont)
Neoechinorhynchus rutili (YT, BC)
Neoechinorhynchus salmonis (BC)
Neoechinorhynchus sp. (BC)
Pomphorhynchus bulbocolli (Alta)

Thymallus arcticus (Pallas) Arctic grayling
Echinorhynchus salmonis (NWT)
Neoechinorhynchus rutili (YT, BC)
Neoechinorhynchus tumidus (YT)

Family OSMERIDAE

Mallotus villosus (Müller) capelin
Echinorhynchus gadi (Atl)

Osmerus mordax (Mitchill) rainbow smelt
Echinorhynchus lateralis (Ont)
Echinorhynchus salmonis (Ont, Que, Atl)
Echinorhynchus sp. (NS)
Leptorhynchoides thecatus (Que, Lab)
Neoechinorhynchus pungitius (Ont)
Neoechinorhynchus rutili (Ont)
Neoechinorhynchus tumidus (Ont)
Pomphorhynchus bulbocolli (Ont)

Family UMBRIDAE

Umbra limi Linnaeus central mudminnow
Leptorhynchoides thecatus (Ont)
Neoechinorhynchus rutili (Ont)
Pomphorhynchus bulbocolli (Ont)

Family ESOCIDAE

Esox lucius Linnaeus northern pike
Echinorhynchus lateralis (Ont, Lab)
Echinorhynchus leidyi (Man, NWT)
Echinorhynchus salmonis (Alta, Man, Que)
Leptorhynchoides thecatus (Ont, Que)
Neoechinorhynchus cylindratus (Ont)
Neoechinorhynchus rutili (YT, BC, Ont)
Neoechinorhynchus strigosus (Alta)
Neoechinorhynchus tenellus (Ont)
Neoechinorhynchus tumidus (YT)
Pomphorhynchus bulbocolli (Ont)

Esox masquinongy Mitchill muskellunge
Echinorhynchus salmonis (Ont)
Leptorhynchoides thecatus (Ont, Que)
Neoechinorhynchus cylindratus (Ont, Que)
Neoechinorhynchus tenellus (Ont)

ORDER CYPRINIFORMES

Family CYPRINIDAE

Carassius auratus (Linnaeus) goldfish
Pomphorhynchus sp. (Ont)

Couesius plumbeus (Agassiz) lake chub
Echinorhynchus salmonis (Ont)
Neoechinorhynchus rutili (BC)

Cyprinus carpio Linnaeus carp
Leptorhynchoides thecatus (Ont)
Pomphorhynchus bulbocolli (Man, Ont)

Hybopsis storeriana (Kirtland) silver chub
Leptorhynchoides thecatus

Mylocheilus caurinus (Richardson) peamouth
Neoechinorhynchus cristatus (BC)
Neoechinorhynchus rutili (BC)
Neoechinorhynchus salmonis (BC)
Pomphorhynchus bulbocolli (BC)

Notemigonus crysoleucas (Mitchill) golden shiner
Neoechinorhynchus notemigoni (Ont)

Notropis anogenus Forbes pugnose shiner
Leptorhynchoides thecatus (Ont)

Notropis atherinoides Rafinesque emerald shiner
Neoechinorhynchus sp. (Ont)

Notropis cornutus (Mitchill) common shiner
Neoechinorhynchus saginatus (Ont)
Acanthocephala gen. sp. (Ont)

Notropis heterolepis Eigenmann and Eigenmann blacknose shiner
Acanthocephala gen. sp. (Ont)

Notropis hudsonius (Clinton) spottail shiner
Leptorhynchoides thecatus (Ont)
Neoechinorhynchus rutili (Ont)
Neoechinorhynchus sp. (Ont)
Pomphorhynchus bulbocolli (Ont)
Pomphorhynchus sp. (Man)

Phoxinus eos (Cope) northern redbelly
Pomphorhynchus bulbocolli (Ont)

Pimephales notatus (Rafinesque) bluntnose minnow
Neoechinorhynchus sp. (Ont)

Ptychocheilus oregonesis (Richardson) northern squawfish
Neoechinorhynchus cristatus (BC)
Neoechinorhynchus rutili (BC, YT)

Neoechinorhynchus saginatus (BC)
Neoechinorhynchus salmonis (BC)
Pomphorhynchus bulbocolli (Alta, BC)

Rhinichthys atratulus (Hermann) blacknose dace
Leptorhynchoides thecatus (Ont)

Richardsonius balteatus (Richardson) redside shiner
Neoechinorhynchus cylindratus (BC)
Neoechinorhynchus rutili (BC)
Neoechinorhynchus sp. (BC, Ont)
Pomphorhynchus bulbocolli (BC)

Semotilus atromaculatus (Mitchill) creek chub
Neoechinorhynchus saginatus (Ont)
Neoechinorhynchus sp. (Ont)

Family CATOSTOMIDAE

Carpiodes cyprinus (Lesueur) quillback
Neoechinorhynchus carpiodi (Ont)
Neoechinorhynchus crassus (Ont)
Neoechinorhynchus sp. (Man)
Pomphorhynchus bulbocolli (Ont)
Acanthocephala gen. sp. (Man)

Catostomus catostomus (Forster) longnose sucker
Echinorhynchus leidyi (Ont)
Echinorhynchus salmonis (Alta, Ont)
Leptorhynchoides thecatus (Ont)
Neoechinorhynchus crassus (Ont, Lab)
Neoechinorhynchus cristatus (BC, Alta, Que. Lab)
Neochinorhynchus rutili (BC, Alta)
Neoechinorhynchus saginatus (BC)
Neoechinorhynchus salmonis (BC)
Neoechinorhynchus strigosus (Ont, Lab)
Neoechinorhynchus sp. (NWT)
Octospinifer macilentus (BC, Ont)
Pomphorhynchus bulbocolli (BC)

Catostomus commersoni (Lacépède) white sucker
Acanthocephalus dirus (Ont)
Echinorhynchus lateralis (Que)
Echinorhynchus leidyi (Ont)
Echinorhynchus salmonis (Alta, Man, Ont)
Leptorhynchoides thecatus (Ont)
Neoechinorhynchus crassus (Sask, Man, Ont)
Neoechinorhynchus cristatus (BC, Alta, Ont)
Neoechinorhynchus cylindratus (Que)
Neoechinorhynchus rutili (BC)
Neoechinorhynchus saginatus (Ont)
Neoechinorhynchus strigosus (Alta, Ont, Lab)
Neoechinorhynchus sp. (Alta, Man, Ont)
Octospinifer macilentus (BC, Alta, Ont)
Pomphorhynchus bulbocolli (BC, Alta, Man, Ont, Que)
Pomphorhynchus sp. (Man)
Acanthocephala gen. sp. (Man)

Catostomus macrocheilus Girard largescale sucker
Neoechinorhynchus crassus (BC)
Neoechinorhynchus cristatus (BC)
Neoechinorhynchus rutili (BC)
Neoechinorhynchus saginatus (BC)
Neoechinorhynchus salmonis (BC)
Octospinifer macilentus (BC)
Pomphorhynchus bulbocolli (BC)

Hypentelium nigricans (Lesueur) northern hogsucker
Neoechinorhynchus saginatus (Ont)

Moxostoma anisurum (Rafinesque) silver redhorse
Leptorhynchoides thecatus (Ont)
Pomphorhynchus bulbocolli (Ont)

Moxostoma erythrurum (Rafinesque) golden redhorse
Pomphorhynchus bulbocolli (Ont)

Moxostoma macrolepidotum (Lesueur) shorthead redhorse
Neoechinorhynchus crassus (Man)
Pomphorhynchus bulbocolli (Man, Ont)
Acanthocephala gen. sp. (Man)

ORDER SILURIFORMES

Family ICTALURIDAE

Ictalurus melas (Rafinesque) black bullhead
Leptorhynchoides thecatus (Ont)

Ictalurus nebulosus (Lesueur) brown bullhead
Acanthocephalus sp. (Que)
Echinorhynchus salmonis (Ont)
Leptorhynchoides thecatus (Ont)
Neoechinorhynchus rutili (BC)
Pomphorhynchus bulbocolli (Ont)
Acanthocephala gen. sp. (Ont)

Ictalurus punctatus (Rafinesque) channel catfish
Leptorhynchoides thecatus (Ont)
Pomphorhynchus sp. (Ont)

Noturus flavus Rafinesque stonecat
Leptorhynchoides thecatus (Ont)

Noturus gyrinus (Mitchill) tadpole madtom
Leptorhynchoides thecatus (Ont)
Pomphorhynchus bulbocolli (Ont)

Family PERCOPSIDAE

Percopsis omiscomaycus (Walbaum) troutperch
Echinorhynchus salmonis (Ont)
Leptorhynchoides thecatus (Ont)
Neoechinorhynchus sp. (Ont)
Pomphorhynchus bulbocolli (Ont)

ORDER GADIFORMES

Family GADIDAE

Gadus macrocephalus Tilesius — Pacific cod
Echinorhynchus gadi (Pac)

Gadus morhua Linnaeus — Atlantic cod
Corynosoma wegeneri (juvenile) (Atl)
Corynosoma sp. (juvenile) (Atl)
Echinorhynchus gadi (W Arc, Atl)
Echinorhynchus sp. (Atl)

Gadus ogac Richardson — Greenland cod
Echinorhynchus gadi (W Arc)

Gaidropsaurus ensis (Reinhardt) — threebeard rockling
Echinorhynchus sp. (Atl)

Lota lota (Linnaeus) — burbot
Echinorhynchus leidyi (Ont)
Echinorhynchus salmonis (Alta, Ont)
Leptorhynchoides thecatus (Ont)
Neoechinorhynchus cylindratus (Ont)
Neoechinorhynchus rutili (YT, BC, Ont)
Neoechinorhynchus saginatus (BC)
Neoechinorhynchus salmonis (BC)
Pomphorhynchus bulbocolli (BC, Ont)
Pomphorhynchus sp. (Man)

Melanogrammus aeglefinus (Linnaeus) — haddock
Corynosoma strumosum (juvenile) (Atl)
Corynosoma sp. (juvenile) (Atl)
Echinorhynchus gadi (Atl)

Merluccius productus (Ayres) — Pacific hake
Echinorhynchus gadi (Pac)

Microgadus proximus (Girard) — Pacific tomcod
Echinorhynchus gadi (W Arc)

Microgadus tomcod (Walbaum) — Atlantic tomcod
Echinorhynchus gadi (Atl)
Leptorhynchoides thecatus (Que)

Pollachius virens (Linnaeus) — pollock
Echinorhynchus gadi (Atl)

Theragra chalcogramma (Pallas) — walleye pollock
Bolbosoma caenoforme (juvenile) (Pac)
Corynosoma strumosum (juvenile) (Pac)
Corynosoma sp. (juvenile) (Pac)
Echinorhynchus gadi (Pac)

Family ZOARCIDAE

Aprodon cortezianus Gilbert — bigfin eelpout
Echinorhynchus gadi (Pac)

Lycodonus mirabilis Chevron — scute pout
Echinorhynchus sp. (Atl)

Macrozoarces americanus (Bloch and Schneider) — ocean pout
Echinorhynchus gadi (Atl)
Echinorhynchus sp. (Atl)
Acanthocephala gen. sp. (Atl)

Family MACROURIDAE

Coryphaenoides rupestris Gunnerus — rock grenadier
Echinorhynchus gadi (Atl)

Macrourus berglax Lacépède — roughhead grenadier
Echinorhynchus gadi (Atl)
Echinorhynchus sp. (Atl)

Nezumia bairdi (Goode and Bean) — marlin-spike
Echinorhynchus gadi (Atl)
Echinorhynchus sp. (Atl)

ORDER ATHERINIFORMES

Family SCOMBERESOCIDAE

Cololabis saira (Brevoort) — Pacific saury
Rhadinorhynchus cololabis (Pac)

Family CYPRINODONTIDAE

Fundulus diaphanus (Lesueur) — banded killifish
Acanthocephalus sp. (NS)
Neoechinorhynchus sp. (Ont)
Octospiniferoides sp. (NS)

Fundulus heteroclitus (Linnaeus) — mummichog
Neoechinorhynchus rutili (Nfld)

ORDER GASTEROSTEIFORMES

Family GASTEROSTEIDAE

Culaea inconstans (Kirtland) — brook stickleback
Leptorhynchoides thecatus (Ont)
Neoechinorhynchus pungitius (Ont)
Neoechinorhynchus rutili (Ont)

Gasterosteus aculeatus (Linnaeus) — threespine stickleback
Echinorhynchus lateralis (Nfld, Lab, Atl)
Neoechinorhynchus rutili (BC, Lab)

Pungitius pungitius (Linnaeus) — ninespine stickleback
Echinorhynchus lateralis (Nfld)
Echinorhynchus salmonis (Alta)
Leptorhynchoides thecatus (Ont)
Neoechinorhynchus cristatus (Que, Lab)
Neoechinorhynchus pungitius (Ont)
Neoechinorhynchus rutili (BC, NWT, Ont, Nfld)
Pomphorhynchus bulbocolli (Alta)

ORDER PERCIFORMES

Family PERCICHTHYIDAE

Morone chrysops (Rafinesque) — white bass
- *Leptorhynchoides thecatus* (Ont)

Morone saxatilis (Walbaum) — striped bass
- *Echinorhynchus gadi* (NB)
- *Neoechinorhynchus rutili* (NB)

Family CENTRARCHIDAE

Ambloplites rupestris (Rafinesque) — rock bass
- *Echinorhynchus lateralis* (Que)
- *Echinorhynchus salmonis* (Ont)
- *Leptorhynchoides thecatus* (Ont)
- *Neoechinorhynchus cylindratus* (Ont)
- *Pomphorhynchus bulbocolli* (Ont)
- *Pomphorhynchus rocci* (Ont)

Lepomis gibbosus (Linnaeus) — pumpkinseed
- *Echinorhynchus salmonis* (Ont)
- *Leptorhynchoides thecatus* (Ont)
- *Neoechinorhynchus cylindratus* (Ont)
- *Pomphorhynchus bulbocolli* (Ont)

Lepomis macrochirus Rafinesque — bluegill
- *Leptorhynchoides thecatus* (Ont)

Micropterus dolomieui Lacépède — smallmouth bass
- *Echinorhynchus lateralis* (Ont)
- *Echinorhynchus salmonis* (Ont)
- *Leptorhynchoides thecatus* (Ont, Que)
- *Neoechinorhynchus cylindratus* (Ont)
- *Neoechinorhynchus rutili* (Ont)
- *Pomphorhynchus bulbocolli* (Ont)

Micropterus salmoides (Lacépède) — largemouth bass
- *Echinorhynchus salmonis* (Ont)
- *Leptorhynchoides thecatus* (Ont)
- *Neoechinorhynchus cylindratus* (Ont)

Pomoxis annularis Rafinesque — white crappie
- *Leptorhynchoides thecatus* (Ont)

Pomoxis nigromaculatus (Lesueur) — black crappie
- *Leptorhynchoides thecatus* (Ont)
- *Neoechinorhynchus cylindratus* (Ont)

Family PERCIDAE

Etheostoma caeruleum Storer — rainbow darter
- *Leptorhynchoides thecatus* (Ont)

Etheostoma exile (Girard) — Iowa darter
- *Echinorhynchus* sp. (Ont)
- *Leptorhynchoides thecatus* (Ont)

Etheostoma flabellare Rafinesque — fantail darter
- *Leptorhynchoides thecatus* (Ont)

Etheostoma nigrum Rafinesque — johnny darter
- *Leptorhynchoides thecatus* (Ont)
- *Neoechinorhynchus cylindratus* (Ont)

Perca flavescens (Mitchill) — yellow perch
- *Acanthocephalus dirus* (Ont)
- *Echinorhynchus lateralis* (Que)
- *Echinorhynchus salmonis* (Ont)
- *Leptorhynchoides thecatus* (Ont)
- *Neoechinorhynchus cylindratus* (Man, Ont)
- *Neoechinorhynchus pungitius* (Ont)
- *Neoechinorhynchus rutili* (Ont)
- *Neoechinorhynchus strigosus* (Man)
- *Neoechinorhynchus tenellus* (Ont)
- *Neoechinorhynchus* sp. (Ont)
- *Pomphorhynchus bulbocolli* (Ont)
- Acanthocephala gen. sp. (Ont)

Percina caprodes (Rafinesque) — logperch
- *Echinorhynchus* sp. (Ont)
- *Leptorhynchoides thecatus* (Ont)
- *Pomphorhynchus bulbocolli* (Ont)

Stizostedion canadense (Smith) — sauger
- *Echinorhynchus salmonis* (Ont)
- *Neoechinorhynchus cylindratus* (Ont)
- *Neoechinorhynchus tenellus* (Ont)
- *Neoechinorhynchus* sp. (Ont)
- Acanthocephala gen. sp. (Ont)

Stizostedion vitreum glaucum Hubbs — blue pike
- *Echinorhynchus* sp. (Ont)
- *Leptorhynchoides* sp. (Ont)

Stizostedion vitreum vitreum (Mitchill) — walleye
- *Echinorhynchus salmonis* (Alta, Ont)
- *Echinorhynchus* sp. (Ont)
- *Leptorhynchoides thecatus* (Ont)
- *Neoechinorhynchus cylindratus* (Man, Ont)
- *Neoechinorhynchus tenellus* (Ont)
- *Neoechinorhynchus strigosus* (Man)
- *Neoechinorhynchus* sp. (Man)
- *Pomphorhynchus* sp. (Man)
- Acanthocephala gen. sp. (Man, Ont)

Family SCIAENIDAE

Aplodinotus grunniens Rafinesque — freshwater drum
- *Leptorhynchoides thecatus* (Ont)
- *Neoechinorhynchus* sp. (Ont)
- *Pomphorhynchus bulbocolli* (Ont)
- Acanthocephala gen. sp. (Ont)

Family EMBIOTOCIDAE

Cymatogaster aggregata Gibbons — shiner perch
- *Corynosoma* sp. (juvenile) (Pac)
- *Echinorhynchus gadi* (Pac)

Family LABRIDAE

Tautogolabrus adspersus (Walbaum) cunner
Echinorhynchus gadi (Atl)

Family ANARHICHADIDAE

Anarhichas lupus Linnaeus Atlantic wolffish
Echinorhynchus gadi (Atl)

Family AMMODYTIDAE

Ammodytes hexapterus Pallas Pacific sand lance
Echinorhynchus gadi (Pac)

Family XIPHIIDAE

Xiphias gladius Linnaeus swordfish
Rhadinorhynchus pristis (Atl)

Family SCORPAENIDAE

Sebastes aleutianus (Jordan and Evermann) rougheye rockfish
Corynosoma sp. (juvenile) (Pac)
Echinorhynchus gadi (Pac)

Sebastes alutus (Gilbert) Pacific Ocean perch
Corynosoma villosum (juvenile) (Pac)
Corynosoma sp. (juvenile) (Pac)
Echinorhynchus gadi (Pac)

Sebastes babcocki (Thompson) redbanded rockfish
Echinorhynchus gadi (Pac)

Sebastes borealis Barsukov shortraker rockfish
Corynosoma sp. (juvenile) (Pac)
Echinorhynchus gadi (Pac)

Sebastes brevispinnis (Bean) silvergray rockfish
Corynosoma sp. (juvenile) (Pac)

Sebastes caurinus Richarson copper rockfish
Corynosoma sp. (juvenile) (Pac)
Echinorhynchus gadi (Pac)

Sebastes ciliatus (Tilesius) dusky rockfish
Corynosoma sp. (juvenile) (Pac)

Sebastes diploprora (Gilbert) splitnose rockfish
Echinorhynchus gadi (Pac)

Sebastes elongatus Ayres greenstriped rockfish
Corynosoma sp. (juvenile) (Pac)

Sebastes fasciatus Storer rosefish
Acanthocephala gen. sp. (Atl)

Sebastes flavidus (Ayres) yellowtail rockfish
Echinorhynchus gadi (Pac)

Sebastes helvomaculatus Ayres rosethorn rockfish
Corynosoma sp. (juvenile) (Pac)
Echinorhynchus gadi (Pac)

Sebastes maliger (Jordan and Gilbert) quillback rockfish
Corynosoma sp. (juvenile) (Pac)

Sebastes marinus (Linnaeus) redfish
Acanthocephala gen. sp. (Atl)

Sebastes proriger (Jordan and Gilbert) redstripe rockfish
Echinorhynchus gadi (Pac)

Sebastes ruberrimus (Cramer) yelloweye rockfish
Corynosoma sp. (juvenile) (Pac)
Echinorhynchus gadi (Pac)

Sebastes zacentrus (Gilbert) sharpchin rockfish
Corynosoma sp. (juvenile) (Pac)
Echinorhynchus gadi (Pac)

Family ANOPLOPOMATIDAE

Anoplopoma fimbria (Pallas) sablefish
Corynosoma sp. (juvenile) (Pac)

Family COTTIDAE

Cottus asper Richardson prickly sculpin
Neoechinorhynchus rutili (BC)
Neoechinorhynchus salmonis (BC)
Pomphorhynchus bulbocolli (BC)

Cottus bairdi Girard mottled sculpin
Echinorhynchus salmonis (Ont)
Neoechinorhynchus rutili (Ont)

Cottus cognatus Richardson slimy sculpin
Neoechinorhynchus rutili (YT)
Neoechinorhynchus tumidus (YT)

Cottus rhotheus (Smith) torrent sculpin
Neoechinorhynchus rutili (BC)
Pomphorhynchus bulbocolli (BC)

Hemilepidotus hemilepidotus (Tilesius) red Irish lord
Echinorhynchus gadi (Pac)

Icelinus filamentosus Gilbert threadfin sculpin
Echinorhynchus gadi (Pac)

Leptocottus armatus Girard Pacific staghorn sculpin
Corynosoma sp. (juvenile) (Pac)
Echinorhynchus gadi (Pac)

Myoxocephalus polyacanthocephalus (Pallas) great sculpin
Corynosoma sp. (juvenile) (Pac)
Echinorhynchus gadi (Pac)

Myoxocephalus quadricornis (Linnaeus) fourhorn sculpin
Echinorhynchus gadi (Lab)
Echinorhynchus salmonis (Ont)

Myoxocephalus scorpius (Linnaeus) shorthorn sculpin
Corynosoma magdaleni (juvenile) (Atl)

Family AGONIDAE

Agonus acipenserinus Tilesius sturgeon poacher
Echinorhynchus gadi (Pac)

ORDER PLEURONECTIFORMES

Family BOTHIDAE

Scophthalmus aquosus (Mitchill) windowpane
Corynosoma sp. (juvenile) (Atl)
Echinorhynchus gadi (Atl)
Echinorhynchus laurentianus (Atl)

Family PLEURONECTIDAE

Atheresthes stomias (Jordan and Gilbert) arrowtooth flounder
Corynosoma villosum (juvenile) (Pac)
Corynosoma wegeneri (juvenile) (Pac)
Corynosoma sp. (juvenile) (Pac)

Eopsetta jordani (Lockington) petrale sole
Corynosoma strumosum (juvenile) (Pac)

Glyptocephalus cynoglossus (Linnaeus) witch flounder
Corynosoma sp. (juvenile) (Atl)
Echinorhynchus gadi (E Arc, Atl)
Echinorhynchus laurentianus (Atl)

Hippoglossoides platessoides (Fabricius) American plaice
Corynosoma sp. (juvenile) (Atl)
Echinorhynchus gadi (E Arc, Atl)
Echinorhynchus laurentianus (Atl)

Hippoglossus hippoglossus (Linnaeus) Atlantic halibut
Corynosoma magdaleni (juvenile) (Atl)
Corynosoma sp. (juvenile) (Atl)
Echinorhynchus gadi (E Arc, Atl)
Echinorhynchus laurentianus (Atl)

Lepidopsetta bilineata (Ayres) rock sole
Corynosoma strumosum (juvenile) (Pac)
Echinorhynchus lageniformis (Pac)

Limanda ferruginea (Storer) yellowtail flounder
Corynosoma sp. (juvenile) (Atl)
Echinorhynchus gadi (Atl)
Echinorhynchus laurentianus (Atl)

Liopsetta putnami (Gill) smooth flounder
Echinorhynchus gadi (Atl)
Echinorhynchus laurentianus (Atl)

Microstomus pacificus (Lockington) Dover sole
Corynosoma sp. (juvenile) (Pac)

Platichthys stellatus (Pallas) starry flounder
Corynosoma strumosum (juvenile) (Pac)
Echinorhynchus gadi (Pac)
Echinorhynchus lageniformis (Pac)

Pseudopleuronectes americanus (Walbaum) winter flounder
Corynosoma semerme (juvenile) (Atl)
Corynosoma sp. (juvenile) (Atl)
Echinorhynchus gadi (Atl)
Echinorhynchus laurentianus (Atl)

Reinhardtius hippoglossoides (Walbaum) Greenland halibut
Corynosoma strumosum (juvenile) (Atl)
Echinorhynchus gadi (E Arc)
Echinorhynchus laurentianus (Atl)

Unspecified fishes

Pomphorhynchus bulbocolli (Can)

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CNIDARIA

M. N. ARAI

ABSTRACT

ARAI, M. N. 1989. Cnidaria, p. 91-95. *In* L. Margolis and Z. Kabata [ed.]. Guide to the parasites of fishes of Canada. Part III. Can. Spec. Publ. Fish. Aquat. Sci. 107: 95 p.

The only species of Cnidaria known from fishes of Canada, *Hydrichthys sarcotretis* (Jungersen), a member of the class Hydrozoa, is described and its taxonomic status briefly discussed.

RÉSUMÉ

ARAI, M. N. 1989. Cnidaria, p. 91-95. *In* L. Margolis and Z. Kabata [ed.]. Guide to the parasites of fishes of Canada. Part III. Can. Spec. Publ. Fish. Aquat. Sci. 107: 95 p.

L'auteur décrit la seule espèce de cnidaires connue chez les poissons du Canada, soit *Hydrichthys sarcotretis* (Jungersen) qui fait partie de la classe des Hydrozoaires, et discute brièvement de sa taxonomie.

INTRODUCTION

The phylum Cnidaria contains multicellular animals possessing intrinsic cnidae (intracellular organelles that function in defense and capture of prey). Species of the phylum parasitic on fish are rare and confined to the class Hydrozoa (Gudger 1928; Hand 1957; Lauckner 1984). Only one species has been collected in Canadian waters — *Hydrichthys sarcotretis* (Jungersen), an ectoparasite. Two other species associated with fish, *Perigonimus pugetensis* Heath and *Polypodium hydriforme* Ussov, will likely be collected in Canada at some future date because they are present in water bodies near the Canadian border.

Perigonimus pugetensis Heath was collected by Heath (1910) and Fraser (1939) from the ventral surfaces of the agonid fish *Hypsagonus quadricornis* (Cuvier) dredged in Puget Sound, Washington, USA. Strong (1925) also mentions a *Perigonimus* species attached to a specimen of *H. quadricornis* collected near Friday Harbor, Washington, but did not describe it. *Perigonimus pugetensis* is a pandeid hydroid with tentaculate hydranths growing singly from a hydrorhizal net and medusae buds with two tentacles at time of release. This species was considered by Rees (1956) to be a synonym of *Leuckartiara octona* (Fleming). However, medusae of *L. octona* have not been collected in Puget Sound (Arai and Brinckmann-Voss 1980), hence the taxonomic position of *P. pugetensis* is still in question. Since entomostracans were found in the gastrovascular cavity, it is unlikely that the hydroid feeds on the fish.

Polypodium hydriforme Ussov is a parasite of the eggs of fishes of the order Acipenseriformes. In North America, *Polypodium* has been discovered in eggs of lake sturgeon, *Acipenser fulvescens* Rafinesque, taken from the Black River near Cheboygan, Michigan (Hoffman et al. 1974) and in eggs of paddlefish, *Polyodon spathula* (Walbaum), from Missouri (Suppes and Meyer 1975; Raikova et al. 1979). A stolon of *Polypodium* with internal tentacles develops within the fish egg. During spawning of the fish the stolon emerges from the egg, everts, and forms tentaculate polyps. This species is considered a highly modified member of the subclass Narcomedusae.

SPECIES ACCOUNT

CLASS HYDROZOA Huxley, 1856

Cnidaria: polymorphic with alternation of polypoid and medusoid generations or with one or other generation suppressed or lacking. Gastrovascular cavity without septa. Mesogloea cell-free. Sex cells ripening in the epidermis. Medusae nearly always with velum, primary tentacles perradial, without rhopalia.

SUBCLASS ATHECATAE Hincks, 1868 — ANTHOMEDUSAE Haeckel, 1879

Hydrozoa: with alternation of generations or reduced to the fixed gonophore-polyp phase. Polyps solitary (rarely) or colonial. Gastrozooids without hydrotheca, gonozooids, when present, without gonotheca, but hydrocaulus, hydrocladia, and stolons, when present, usually enclosed with chitinous perisarc. Medusae, when present, with umbrella usually deep bell-shaped; with gonads exclusively on the manubrium, or on the manubrium and extending a slight distance on the radial canals; with or without ocelli; lacking statocysts; with marginal tentacles implanted on the exumbrellar border.

ORDER FILIFERA Kühn, 1913

Athecatae–Anthomedusae: hydroids rarely without tentacles, usually with filiform (tapering) tentacles. Medusae, when present, with gonads disposed on the manubrium in longitudinal masses; buccal opening with four lips.

PANDEIDAE Haeckel, 1879

Filifera: hydroids generally stolonal with claviform hydranths, not polymorphic, typically with a distal ring of tentacles. Medusae with apical projection in most genera; with large manubrium; with four radial canals (except eight of *Octotiara*); gonads situated adradially or interradially on stomach wall, rarely on perradii on subumbrella; tentacles filiform, hollow, with conical marginal bulbs.

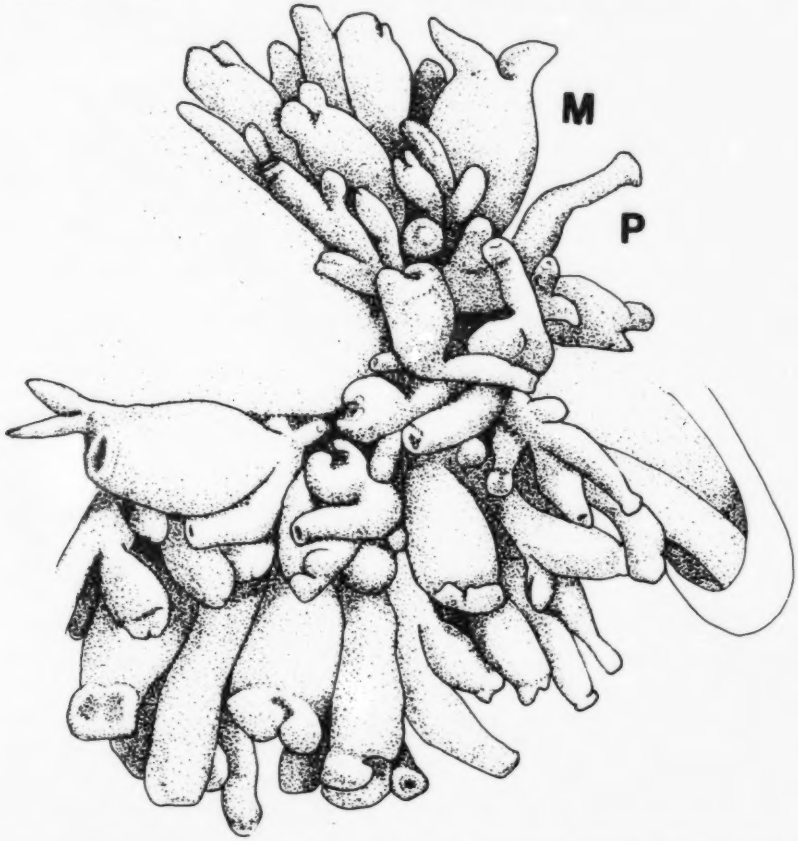

FIG. 1. Portion of colony of *Hydrichthys sarcotretis* attached to the copepod *Sarcotretes scopeli* on the fish *Benthosema glaciale*. Redrawn from Jungersen 1911. M. Medusa-bud. P. Polyp. Magnification not noted on original.

Hydrichthys Fewkes, 1887

Pandeidae: hydroids parasitic on fish; polyps elongate, without tentacles, issuing from a plate-like hydrorhiza without perisarc, either on the fish or on a copepod attached to the fish. Adult medusae unknown, young medusae when known similar to young Pandeidae.

Hydrichthys sarcotretis (Jungersen, 1911) Lauckner, 1984 (Fig. 1, 2). Hydroid attached to copepod, although feeding on fish tissue, polyps up to 14 mm long, without nematocysts. Medusae released with 2 or 3 tentacles, up to 1.7 mm high including tentacles, with exumbrella nematocysts.

Syn: *Ichthyocodium sarcotretis* Jungersen, 1911.

On copepod *Sarcotretes scopeli* Jungersen, attached to *Benthosema glaciale* (Reinhardt) (1): on copepod *Sphyrion lumpi* Krøyer attached to *Sebastes mentella* Travin (2).

Records: 1. Jungersen 1912 (E. Arc); 2. Templeman 1973 (Atl).

Remarks: Larson (1982) described the life cycle of the pandeid medusa *Stomatoca pterophylla* Haeckel with a hydroid morphologically similar to that of *Hydrichthys*. He synonymized the genus *Hydrichthys* with *Stomotoca*. However, the type species of *Hydrichthys*, *H. mirus* Fewkes, was shown by Fewkes (1887, 1888a, 1888b) to develop into an immature medusa with four tentacles. *Hydrichthys mirus* can therefore not be a species of *Stomotoca* because the latter genus is characterized by adult pandeid medusae with two tentacles, i.e., the hydroid genus *Hydrichthys* must be retained. Due to the small number of morphological characters of these parasitic hydroids and their variation with environmental conditions, further clarification of the taxonomy will depend on rearing and identification of the mature medusae of each species of *Hydrichthys*. *Hydrichthys sarcotretis* was described by Jungersen (1911) in the monospecific genus *Ichthyocodium*. This genus is retained by Bouillon (1985) in his classification of the Hydrozoa, being distinguished from *Hydrichthys* and *Stomotoca* by the attachment of the hydroid to a parasitic copepod rather than directly to the fish. However, McCormick et al. (1967) found a *Hydrichthys* sp. attached to both a parasitic copepod and a fish. As they stated, a clear distinction between the genera cannot be based on this character. *Ichthyocodium* is therefore a junior synonym of *Hydrichthys* as proposed by Lauckner (1984) in his recent review.

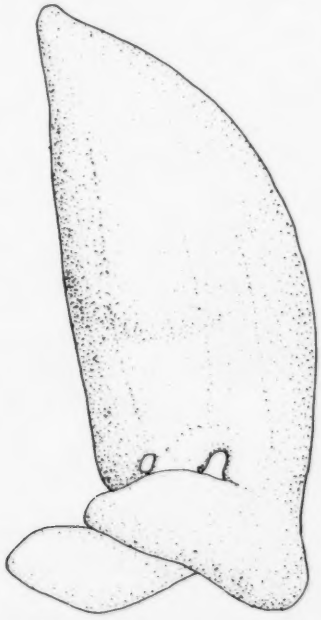

FIG. 2. Medusa-bud of *Hydrichthys sarcotretis*. Redrawn from Jungersen 1911.

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